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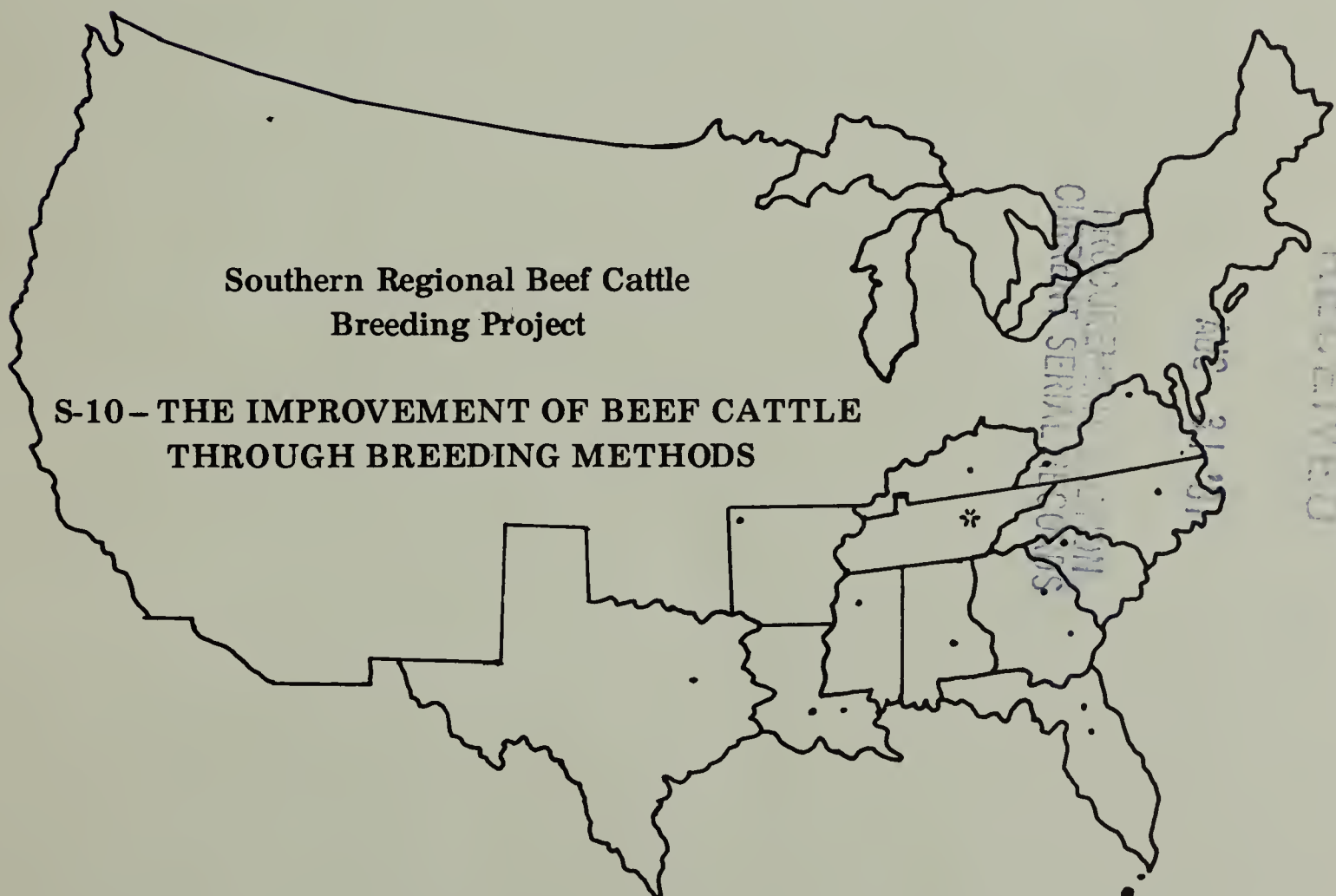


1972

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UNITED STATES DEPARTMENT OF AGRICULTURE  
AGRICULTURAL RESEARCH SERVICE  
ANIMAL SCIENCE RESEARCH DIVISION  
and  
COOPERATING SOUTHERN STATES

**1970-1971 Annual Report of S-10  
and  
Report of Annual Technical Committee Meeting  
Baton Rouge, Louisiana  
June 9-11, 1971**



This report is intended for the use of administrative leaders and workers  
and is not for general publication.



S-10 - 1971 ANNUAL REPORT



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## INTRODUCTION

This project was initiated in 1948 to investigate and develop methods of breeding more productive beef cattle for the South. Detailed annual reports showing research developments and progress in each state have been prepared each year since 1950. Complete results of certain phases of the project have been reported in regional bulletins and technical articles and bulletins published by workers in the various states which contribute to the S-10 project.

This publication includes the proceedings of the 1971 annual meeting of the S-10 Technical Committee and the annual reports of projects in each of the twelve contributing states. The annual reports of S-10 contributing and supporting projects were prepared by the project leaders and other personnel at the various stations as summaries of the research developments and progress at each station during 1970. The results are not considered final, but the materials aid cooperators in developing an integrated program. This report also provides information needed by heads of animal husbandry departments, experiment station directors, and U. S. Department of Agriculture officials for evaluation of the projects with respect to objectives and procedures. This report is not for general distribution and material contained in it should not be quoted in publications.

## ANNUAL MEETING

## S-10 TECHNICAL COMMITTEE MEETING

Louisiana State University  
Baton Rouge, Louisiana

June 9, 10 and 11, 1971

Wednesday, June 9  
Prince Murat Inn

Presiding: R. R. Shrode

8:30 a.m.	Open 1970-71 S-10 Annual Meetings	R. R. Shrode
8:35 a.m.	Welcome	Dr. Doyle Chambers
8:50 a.m.	Program Outline (Tour)	J. W. Turner
9:00 a.m.	Alabama Station Report	
9:20 a.m.	Arkansas Station Report	
9:40 a.m.	Florida - University	
10:00 a.m.	Coffee Break	
10:20 a.m.	Florida - Brooksville	
10:40 a.m.	Georgia	
11:00 a.m.	Kentucky	
11:20 a.m.	Louisiana - New Iberia	
11:40 a.m.	Louisiana - Baton Rouge	
12:00 noon	Lunch	
1:30 p.m.	S-10 Investigations Leader Report:	
	(a) New project proposals	
	(b) Regional publications	
	(c) Discussion of regional needs, ideas and functions of S-10 research effort	
3:00 p.m.	Coffee Break	
3:30 - 5:30	Tour Ben Hur; St. Gabriel facilities	
7:00 p.m.	Dinner - Giant Step Room	
	Guest Cajun Speaker	Dr. J. B. Fancioni, Jr.

Thursday, June 10  
LaSalle Industrial Room

Presiding: J. W. Turner

8:00 a.m. Program Speaker - National Sire Evaluation Program R. L. Willham

8:30 a.m. Program Speaker - Dairy-Beef Crosses R. L. Willham

9:15 a.m. Program Speaker - MARC Progress Report G. E. Dickerson

10:00 a.m. Coffee Break

10:30 a.m. Business Session

(a) Regional advisor

(b) USDA advisor

(c) CSRS

(d) Business

(e) Election of officers

(f) Adjourn for tour

12:00 noon Lunch

1:00 p.m. Tour of Project 1442 - Idlewild Plantation

3:15 p.m. Leave for Lafayette, Louisiana (Holiday Inn)

7:30 p.m. Attend horse races (if prefer)

Friday, June 11

7:15 a.m. Drive to Iberia Station for tour

10:00 a.m. Leave station for Bar M Ranch - Covington, Louisiana

12:00 noon Lunch - Houma, Louisiana

1:00 p.m. Leave Houma for Covington

3:00 p.m. Bar M Ranch

5:00 p.m. Depart for New Orleans - Jung Hotel

7:00 p.m. Hospitality Hour sponsored by Bar M Ranch

Concluding remarks and adjournment of S-10 Meetings  
for personal dinner and evening in New Orleans.

## MINUTES OF S-10 TECHNICAL COMMITTEE MEETING

Baton Rouge, Louisiana

June 9-11, 1971

The S-10 meeting was convened by Chairman R. R. Shrode at 8:45 a.m. on June 9 in the LaSalle Industrial Room of the Prince Murat Inn. Chairman Shrode introduced Dr. Doyle Chambers who welcomed the group to Louisiana and briefly discussed agricultural production in the state. Chairman Shrode then introduced J. W. Turner who outlined the proposed tour planned for the S-10 group.

Station reports were presented by the following personnel from the various stations:

Alabama - T. B. Patterson, Auburn University, Auburn  
Arkansas - C. J. Brown, University of Arkansas, Fayetteville  
Florida - M. Koger, University of Florida, Gainesville  
Florida - W. C. Burns, Beef Cattle Research Station, Brooksville  
Georgia - H. D. Chapman, Georgia Coastal Plains Experiment Station, Tifton  
Kentucky - F. A. Thrift, University of Kentucky, Lexington  
Louisiana - T. M. DeRouen, Iberia Livestock Experiment Station, Jeanerette  
Louisiana - J. W. Turner, Louisiana State University, Baton Rouge

The meeting adjourned for lunch at 12 Noon and reconvened for the afternoon program at 1:30 p.m. Chairman Shrode introduced the S-10 Investigations Leader, W. T. Butts, USDA, Knoxville, Tennessee, who stated that two new projects were being prepared--one at Texas for the McGregor Station and one at South Carolina. Dr. Butts turned the discussion over to T. C. Cartwright and Dick Thomas to present a preliminary consideration of the proposed project for the McGregor Station. Dick Thomas illustrated that the proposed project would involve crossing of Hereford, Brahman, Jersey, Holstein and Angus breeds. Considerable discussion followed the project outline.

Dr. Butts asked for suggestions as to how the S-10 Technical Committee should review new proposed projects. It was suggested that new proposals be sent to Dr. Butts who would then forward the proposal to the various Technical Committeemen. Each Technical Committeeman would then send his comments concerning the proposal to Dr. Butts who would summarize the comments and forward them to the project leaders.

Dr. Butts also stated that work was being done on two regional publications--one dealing with crossbreeding and the other with breed characterization. Dr. Butts also asked for comments concerning collection of data from the various states to estimate heritability of fertility. Little response was obtained from the group.

The meeting was adjourned at 3 p.m. by Chairman Shrode for the tour of the cross-breeding research at the Ben Hur and St. Gabriel facilities.

Chairman Shrode called the meeting to order on June 10 at 8 a.m. and introduced Dr. Richard Willham, Iowa State University, Ames, who discussed the National Sire Evaluation Program of Beef Improvement Federation and Dairy-Beef crossbreeding research being conducted at the Iowa Station. Papers presented are included in the S-10 annual report.

Chairman Shrode introduced Dr. G. E. Dickerson from the U. S. Meat Animal Research Center, Clay Center, Nebraska, who discussed the current status of the breed of sire evaluation work being conducted at MARC.

Resolutions were presented by J. A. Gaines and their acceptance was recommended. They were approved as read:

Report of S-10 Resolution Committee  
June 1971

1. BE IT RESOLVED that the S-10 Technical Committee, at its Silver Anniversary Meeting, held in Louisiana, was most graciously received and cared for. This pleasant circumstance was largely the result of magnificent efforts on the part of J. W. "Bill" Turner, who therefore deserves the most heartfelt thanks of the Committee.
2. BE IT FURTHER RESOLVED that the thanks and appreciation of the group be expressed to the host Department Head, Dr. George Robertson; the host Director, Dr. Doyle Chambers; the guest speakers, Dr. Richard Willham and Dr. Gordon Dickerson; and all our hosts for tours and programs.
3. BE IT FURTHER RESOLVED that the Committee is indebted to an alumnus, Dr. Noah England, for a tour of Bar M Ranch and a "happening" in New Orleans, and that thanks be expressed.
4. BE IT FURTHER RESOLVED that special thanks of the Committee be expressed to "Prof." Francioni for his enlightening and enlivening speech dealing with the three factor interaction of the human "fun" syndrome, the animal scientist, and the livestock world.
5. BE IT FURTHER RESOLVED that the thanks of the Committee be expressed its Chairman, Dr. R. R. Shrode, whose initials are highly correlated with the manner in which he conducted the sessions.
6. BE IT FURTHER RESOLVED that all those concerned receive copies of these resolutions.

C. J. Brown extended an invitation to hold the 1972 meeting in Arkansas. Dr. Patterson moved acceptance and Dr. Dillard seconded that the invitation be accepted. The motion carried.

C. J. Brown was elected as the new member of the executive committee. Thus, the executive committee for the coming year will be:

F. A. Thrift - Chairman  
T. B. Patterson - Secretary  
C. J. Brown

T. C. Cartwright moved that each S-10 Technical Committeeman be given a chance to review the Beef Improvement Federation and send comments to Will Butts. Dr. Koger seconded the motion which carried.

Comments were heard from the following:

Regional Advisor - Doyle Chambers, Louisiana State University, Baton Rouge  
ASR, USDA Advisor - Paul Putnam, Beltsville, Maryland  
USDA, CSRS - Estel Cobb, Washington, D.C.

Dr. Chambers stressed the importance of preparing regional publications to help justify the overall S-10 project.

Dr. Putnam discussed organizational changes in USDA.

Dr. Cobb stated that he would like to review our S-10 projects at the same time they are reviewed by the various Technical Committeemen.

Chairman Shrode relinquished the chair to F. A. Thrift who adjourned the meeting at 11:30 a.m. The Idlewild Plantation was toured on the afternoon of June 10 and on June 11 the group toured the Iberia Station and Bar M Ranch.

Respectfully submitted,

F. A. Thrift, Secretary

## SIRE EVALUATION AND THE BEEF BREEDER

R. L. Willham  
Iowa State University

The Beef Improvement Federation since its inception three years ago, has concerned itself with a class of beef industry problems that deal with performance, program design and development. A national performance program is, in essence, the breeding program since it suggests the goal, prescribes the measurements, and develops the selection criteria. The breeding program of a species determines its ultimate relevance. BIF has undertaken an awesome task.

This spring, after three years of committee activity, BIF came out with recommendations for breed-wide sire evaluation programs. The purpose of this paper is to review this proposed system of sire evaluation and consider briefly the role of beef cattle breeders in the design and conduct of specific breed-wide programs by the beef industry.

### Sire Evaluation

Sire selection and consequently sire evaluation for the heritable production and product traits are paramount to beef improvement especially on a within breed basis. This improvement (pounds of retail product of acceptable eating quality produced during the relevant commercial growth period) can be transmitted directly to the commercial producer even though he may be crossing breeds to exploit the heterosis available in reproduction and to combine breed strengths into a sound commercial product. The potential for commercial crossbreeding dictates the use of breed-wide programs to preserve the breeds for crossbreeding.

The purpose of a breed-wide sire evaluation program is to develop procedures whereby a large number of sires can be compared on the performance of their progeny. These procedures are integrated with sound herd breeding programs such that when conducted, the results will be more effective sire selection for the breeders.

Essentially two statistical procedures exist whereby accurate comparisons among a large number of sire progeny groups can be made. The first approach is to test sires, in enough herds in which a large number of other sires are represented, such that the sires are compared in the average herd and against the average sire. This approach is highly dependent on getting sires used in enough herds so the assumption of randomness is fulfilled. This approach requires widespread use of artificial insemination. It is the basis of the USDA dairy sire evaluation program.

The second approach is to designate certain sires as reference bulls. These are then used each time a progeny test is conducted in a herd and consequently all sires that have been progeny tested can be compared with every other sire through the reference bulls. This approach assumes that sires will rank the same under all herd environments. It does not require AI except in the use of the reference sires. It is compatible with current breeding programs in that within a herd bulls can be selected on own performance and these progeny tested along with the reference sires, making sire selection much more effective than a within herd program.

The second statistical procedure, that of using reference sires, was chosen rather than the other, because it fit neatly into the existing context of herd breeding

programs and there is not the widespread use of AI in the beef industry necessary for the first procedure. The reference sire systems is an attempt to use a statistical design in the evaluation of sires. Its merit will be revealed in the performance of bulls used extensively in AI service subsequently.

### Basic Program

The basis of any national sire evaluation program is a myriad of sound herd breeding programs. Thus, the description of a national sire evaluation program begins with the herd breeding program. Within a breeding stock herd, sire selection is paramount. Because of the heritability of the production and product traits, 40 to 60%; some sequential selection scheme will result in near maximum genetic change. A sequential scheme involves selection first on own performance followed by selection among those selected based on the performance of their progeny.

Performance Test. The first step is the development and conduct of a performance testing program that involves obtaining the 205 day, age of dam adjusted weaning weights and the average daily gain on a standard 140 day feedlot test for each contemporary bull group. These figures compose adjusted yearling weight (adjusted weaning weight plus 160 times average daily gain). Either own performance for yearling weight or own performance and all other relative information available on yearling weight properly weighted is a satisfactory criterion for selection among yearling bulls. The top yearling bulls within the contemporary group treated alike are candidates for the progeny test. As the program develops, the carcass progeny test of a sire can be used to advantage as a sib test for his sons, although used in this way it is just half as accurate. The bulls not in line for progeny testing can be merchandized easily on performance. Young bulls can also be tested in central tests and the superior ones retained for testing. Using a central test helps compare herds and sires and provides a show ring of performance.

Progeny Test. The second step is the development and conduct of a progeny testing program that involves obtaining the pounds of retail product of acceptable eating quality produced in 365 days where approximately 205 days were spent on the cow and 160 days were spent under commercial feedlot conditions for each contemporary sire group. This program can either be conducted within the herd or in one or several commercial herds. The breed of cow used is not important, but the assignment of these cows to the sires to be tested is critical. The assignment must be stratified over known cow differences such as age and then randomized within the strata. The cows and resulting progeny must be managed as nearly alike as is physically possible. The only known difference among sire groups must be the sire differences which are being evaluated.

At least two sires, and preferably more, must be progeny tested together if any selection is to be practiced based on the results of the test. The sires involved in such a progeny test can be ranked based on the average performance of their progeny obtained by conventional least squares--maximum likelihood statistical procedures. Progeny numbers per sire evaluated should be at least 20 for reasonable accuracy. The selected sires can then be used as herd bulls until being replaced by superior sons. Some gamble is in order to help circumvent the two year delay in progeny testing. The yearling bulls being progeny tested can be allowed to sire calves in the breeding herd. When this is done the superior progeny tested bull will already have a few sons in the breeding herd ready for testing.

Since accuracy of selection and intensity along with the generation interval are antagonistic, compromise among these components of selection response is necessary to

optimize any given set of herd conditions for maximum genetic progress per unit of time. Thus, within the context of sequential sire selection there are real opportunities to increase progress by optimizing the scheme. How many young bulls should be selected for testing? How many progeny per bull and how many bulls give optimum response for the progeny test with a fixed set of cows? How should the breeding herd be allocated to yearling and progeny tested bulls for maximum progress? Answers to these sorts of questions spell the difference between the superior and ordinary herd breeding program.

National Program. Now for a breeder to become involved in a national sire evaluation program requires that he use a set of reference sires as he does his own young bulls in his progeny testing program. This will require the use of AI at least for breeding to the set of reference sires. Stratification and randomization of cows and equal treatment for progeny of reference sires is an obvious must. Then using the difference between the progeny of a sire and the progeny of the reference sires (called "EXPECTED PROGENY DIFFERENCE") any other sire in the breed can be compared. All sires in the breed can be ranked relative to each other through the reference sires. This procedure amounts to the same thing as progeny testing all sires of a breed in one large herd. Thus, the breeder has the advantage of numbers in sire selection and a real knowledge of where the superior germ plasm is in the breed. If he has the superior sires, he reaps the rewards of superiority, but if he has only average sires, he can accurately evaluate where the germ plasm he needs is and help exploit it. These benefits of the breed-wide system would occur even if only the superior X percentage of bulls were published or if all the bulls involved in the test were reported as ranked.

Reference Sire System. For a breed to have a sire evaluation program requires cooperative effort on the part of the individual and corporate breeder to develop and conduct a sound reference sire system. The criteria for reference bulls are those who have a large number of progeny evaluated in a large number of herds such that a comparison made through this bull has a low prediction error. The necessity to cooperate with a bull stud in the collection, storage and distribution of reference sire semen is obvious. The breeders must designate sires to be reference bulls at the outset and develop criteria for new reference sires. This program offers the unique opportunity to actually measure genetic change in the breed over time by comparing back to the initial set of reference sires.

The first set of reference sires can be chosen in any manner desired. They could be the superior set of sires based on a central performance test. A set (all) reference sires could be used in each herd test such that each reference sire was tested with every other reference sire in the same herd many times. Then as the data accumulated, the reference sires could be evaluated with a very low prediction error. Reference sires could be replaced yearly with the superior sires recognized from the previous test.

The least squares--maximum likelihood comparisons ("EXPECTED PROGENY DIFFERENCES") among sires of the breed would be the responsibility of the program as would the within-herd comparisons made for the individual breeders. The specific program must develop its own set of rules governing the publication of the resulting data and the specific choice of the set of traits to be reported as expected progeny differences.

#### Role of Beef Breeders

A first attempt at breed-wide sire evaluation has been developed by a BIF committee and the report adopted by BIF. As researchers and trained animal breeders we have a role to play not only in the design but in the implementation of such a program.

First, we must all be acquainted with the recommendations and constructively criticize the program. Now is the time to spot deficiencies and correct them rather than to label the resulting programs as "duds". Second, we must actively support and encourage the breed associations or other organizations to develop creative programs based on BIF recommendations. We may just have to deal in politics to get the job accomplished. Every member of every board of directors of the breed associations needs to be thoroughly acquainted with the program personally by someone who can adequately explain and defend the program. This needs to be someone having the respect of the director. Each of us have directors in our state and our area of concern. Those of us acquainted with association personnel must encourage them to develop a program. Every chance we get to expound on breeding in the popular press should include some reference to breed-wide sire evaluation. Third, when such programs are developed and on the books each one of us needs to encourage breeders in our state to become involved in the program. The Polled Hereford Program is developed and the first ten reference sires designated. Now is the time to personally see each Polled Hereford breeder in our area and go over the program with him and actually help him develop a sound breeding program that includes the use of a set of reference sires. Right now the big excuse is "no commercial herds that can use AI" are available. The new breeds have put a premium on them. But a breeder with over 200 cows could divide his herd and progeny test using the bottom end of his cows. He can also use both steers and heifers which will increase the number of young bulls he could test even in his own herd. Maybe we can help get some commercial and breeding herds together.

Our ivory tower approach to breeding is over, if we really want to see the beef industry apply breeding technology as it can. We must get with it and jump into the economic world of dollars and cents. This means devising programs that make money and helping them get accepted and conducted. We will still have time to analyze our data because it will be more meaningful to us.

### Summary

The purpose of a breed-wide sire evaluation program is to enhance the effectiveness of selection in the breeding programs of all the herds of the breed by providing a procedure whereby the expected progeny difference of many sires can be accurately compared over the entire breed. The accuracy and intensity of sire selection as well as the amount of genetic variability available (the product of the three compromises selection response per generation), all will be increased over what might be achieved by even the biggest herds using only a within-herd sire selection scheme. Improved response depends on exploiting the superior germ plasm when evaluated. Although the goal and means to achieve it are relatively simple, the achievement depends on the willingness of independent breeders to cooperate in the development and conduct of the evaluation program, on their willingness to compete with one another using the performance merit of their cattle, on their willingness to exploit the superiority, and on the ability of beef breeders to help sell such a program. The sire evaluation program offers to all breeders the opportunity to utilize breeding technology in their own breeding programs and the opportunity to effectively compete with all breeders. It allows the beef breeder the opportunity to apply beef breeding technology!

## SINGLE CROSS BEEF-DAIRY STEER PERFORMANCE

R. L. Willham  
Iowa State University

Many factors in recent years have caused the beef industry to inquire about new sources of germ plasm and their use in commercial crossbreeding. That crossbreeding produces economic heterosis especially for the reproductive complex in cattle and has been amply demonstrated. See Cundiff (1970). Besides this advantage in heterosis, the commercial producer can incorporate genetic material that has a simple additive advantage and he can put together into a market animal the desirable traits of several breeds (Willham, 1970). These latter two points are as important as the production of heterosis.

The last few years have seen the rise of the Charolais as a major beef breed in the United States. Now a vast number of breeds from the continent of Europe are being imported and sampled by the beef industry. Besides the obvious growth rate advantage of these breeds there is the fond hope that crossing of more "genetically divergent" breeds will result in more heterosis. If, in fact, these breeds do differ in gene frequency for these genes that have dominance and influence the various performance traits, then the amount of heterosis expected at such a locus is  $(\Delta p)^2 d$  where  $\Delta p$  is the difference in gene frequency between the breeds crossed and  $d$  is the dominance deviation (Willham, 1970).

Evidence to date with the Charolais breed suggests that there is little if any increase in the percentage of heterosis produced by the Charolais in combination with the Hereford and Angus breeds (Cundiff, 1970). Martin (1971) in a review of beef-dairy crossbreeding indicates little heterotic advantage in beef by dairy crosses compared with either beef or dairy crosses. But there is real evidence that the domestic Hereford breed combines with other breeds to produce a higher percentage of heterosis than the Angus, Shorthorn, and Charolais breeds do. See Cundiff (1970) for a review of this evidence.

Besides the intense interest in the newly imported breeds, there has been considerable interest in the possible use of American dairy breeds in beef production. These American exotics include the Holstein-Friesian, Jersey, and especially the Brown Swiss breeds. They too, by their breeding for milk production rather than beef would suggest the possibility of obtaining more heterosis in the cross than with conventional beef crosses such as the Hereford-Angus cross. To evaluate two dairy breeds in beef production, the Iowa station initiated a project in 1967.

The purpose of the Iowa beef cattle breeding project (a contributor to the North Central Regional Beef Cattle Breeding Project) is to examine the introduction of dairy blood in an intensive beef production system. Hopefully, such a system or derivative could be used for intensive cornbelt beef production. The project was designed to evaluate growth potential, carcass merit, and maternal performance in beef production offered by two dairy breeds (Holstein-Friesian [F] and Brown Swiss [B]) in comparison with two British beef breeds (Angus [A] and Hereford [H]). Phase I of the project involves the production and measurement of calves from all possible combinations ( $4 \times 4 = 16$ ) among the two beef and two dairy breeds. Phase II of the project uses the single cross heifers and a sample of crossbred bulls from Phase I to evaluate the maternal performance of the six single crosses by producing backcross calves using both single cross heifers mated to straight bred bulls and straight bred heifers mated to crossbred bulls.

The purpose of this paper is to examine the resulting heterosis obtained when crossing two beef and two dairy breeds. The preliminary results on the production and product traits of the steer calves from the first two calf crops of single crosses in Phase I of the project will be used to examine the heterosis. Only growth potential and carcass merit will be considered, leaving the evaluation of maternal performance in the single cross until Phase II has been completed.

### Experiment

The project was initiated in the fall of 1967 with the purchase of 200 commercial yearling heifers from each of the breeds. They were equally divided between two Iowa farms. Eighty bulls, 10 per breed per year, was used in a complete AI program. The management system involved fall calving (October-November from breeding in January-February), to compliment crop production such that new technology like AI could be better utilized. Intensive feeding of steer calves (creep feeding from 60 days followed at 180 by a high concentrate ration) to produce finished beef at 13 to 14 months was practiced. Large feedlots with feed bunks and shelter were used to winter the cow and calf and to finish the steers after weaning. The balanced creep ration contained 80% shelled corn. At farm A the finishing ration averaged 70% ground shelled corn, 25% corn silage, and 5% supplement while at farm C the first year the ration averaged 80% high moisture ground ear corn, 15% haylage, and 5% premix. The second year the base was ground shelled corn. During the winter (December to May) cows were fed corn and either corn silage or haylage. Difficulty was encountered in rebreeding the heifers with their first calf at side, so calves in the first calf crop were weaned at an average age of 90 days at both farms. Calves remained on creep to 180 days. This weaning schedule was used on farm C the second calf crop while on farm A calves were creeped but left on their dams to 180 days when they were weaned. The first calf crop was all from heifers, but in the second crop about half of the calves were from second calf heifers and the others from heifers calving first at about three years, since the heifers not calving the first year were retained for breeding the second. The steer calves from farm A were slaughtered both years when they averaged 13 months of age and those from farm C at 14.5 months. At both farms in both years the calves had severe respiratory infections when the weather warmed in late winter.

Putting together commercial heifers from at least 40 diverse origins plus a first attempt at using complete AI plus two extremely cold and wet winters (breeding in January and February) equals problems in getting good conception rates. However, such procedures quickly uncover differences. Table 1 presents the conception rates (cows calving as a percent of cows exposed) for the four breeds of cow by years and farms. The biggest difference is between farms which is due in part to a more severe environment (less condition on the cows) at farm C. The conception at farm A is about equal for dairy and beef while at farm C the dairy is declining under the poorer conditions. Although the reproductive performance of the crossbreds is the issue, the straight Brown Swiss appear to adapt to the beef program less well than do the Holstein.

The crossing of breeds differing in general size will produce a higher incidence of calving difficulty. Table 2 presents the calving difficulty scores (1 to 17 from easy to difficult) that involve presentation, position, and amount of assistance given. The first column gives the scores for the straight bred calves.

Crossbreeding increased slightly (3.2 compared with 2.8) the incidence of difficulty. The ranking of the second two columns is nearly reversed with Angus bulls, when mated to the other three breeds of cow, giving the least problem and Angus cows giving the most. Using dairy bulls increases the incidence of difficulty even when one of the three breeds of cow is dairy.

Table 1. Conception Rates.

Farm		A		C	
Year					
Dam		1968	1969	1968	1969
A	:	56	77	41	53
H	:	71	72	47	51
F	:	82	82	62	47
B	:	68	60	43	36

Average: 69 73 48 46

A=Angus, H=Hereford, F=Holstein &  
B=Brown Swiss.

Table 2. Calving Difficulty Scores.

Breed	Straight	Crossbred	
	Bred	As Sire	As Dam
A	3.4	2.6	4.3
H	2.5	2.8	3.9
F	2.9	3.8	3.1
B	2.6	3.7	1.7

Average: 2.8 3.2

Table 3. Number of Male Calves.

Dam						Totals
Sire	:	A	H	F	B	
A	:	23	24	37	22	: 106
H	:	25	23	34	29	: 111
F	:	24	26	35	20	: 105
B	:	27	20	27	19	: 93

Totals : 99 93 133 90 : 415

breeding system especially when the small breed of dam is used. The 81 pound average is for first and second calf heifers.

The preliminary results of the two years of single crosses will be presented in 4 x 4 tables. The breed of sire and breed of dam means appear around these tables. The values of the traits in the tables are least squares means that have been adjusted for other variables such as farms, years, and birth date. Linear regression was used to adjust the data to a common calving date.

### Results

Table 3 presents the number of calves available in each of the cells of the tables to be presented. Carcass data does not include the 44 head of bull calves saved in the first calf crop for use in Phase II of the project. Six of each single cross ignoring reciprocals and two of each straightbreed were saved as bulls. Adjustment of bull data was made to a steer equivalent by multiplying the weights by .97.

Tables 4, 5, and 6 give the least squares means for birth, 180 day, and 365 day weight after adjustment for other variables. The weights were calculated using the previous adjusted weight plus the number of days times the average daily gain for the particular period. Weights are reported in pounds. Mid and yearling weights were the average of two weights.

For birth weight, the percentage of variance after adjustment for other variables was 8% for breed of sire, 39% for breed of dam, 3% for breed of sire by breed of dam interaction, and 50% for remainder. Almost 40% of the variance in table 4 is due to the difference in birth weights of the calves from beef and dairy dams. Heterosis for birth weight, as indicated by the interaction (3%), is not a large source of variation, which is good. Large weights at birth can be a source of calving difficulty in a cross-

For mid or 180 day weight, only 3% of the variation was due to breed of sire, 41% was due to breed of dam, 4% was due to interaction, and 52% was remainder. Again breed

of dam, the beef versus dairy comparison, accounted for the majority of the variance in table 5. The figures in table 5 represent weaning at 90 days in 3 of the 4 farm-year groups. When considering the same tables for each of the farm-year groups, the least squares mean of farm A in 1968 was 450 pounds as it was in 1969. No advantage was gained by leaving the calves on the extra 90 days. The extra 100 pounds of calves from dairy cows seen at 180 days was almost there at 90 days.

Table 4. Male Birth Weight in Pounds.

Sire <sup>Dam</sup> :	A	H	F	B	:	BS
A :	63	70	86	80	:	75
H :	71	72	89	85	:	79
F :	75	80	88	90	:	83
B :	72	80	101	90	:	85
BD :	70	75	91	86	:	81

Table 5. Male Mid Weight in Pounds.

Sire <sup>Dam</sup> :	A	H	F	B	:	BS
A :	373	398	494	488	:	438
H :	412	360	501	473	:	437
F :	438	416	492	502	:	462
B :	426	432	518	482	:	465
BD :	412	401	501	486	:	450

Table 6. Male Yearling Weight in Pounds.

Sire <sup>Dam</sup> :	A	H	F	B	:	BS
A :	805	867	978	979	:	907
H :	881	826	1017	974	:	925
F :	921	922	1001	1018	:	966
B :	914	964	1060	957	:	974
BD :	880	895	1014	982	:	943

For yearling weight, 6% of the variation was due to breed of sire, 27% to breed of dam, 6% to interaction, and 61% for remainder. Breed of sire influence is increasing in importance as is the indication of heterosis as shown in the interaction. The breed of dam effect is still present (about 100 pounds favoring the dairy cow compared to the beef cow) although almost this much difference was present at 180 days. Holstein dams appear to have the advantage over the Brown Swiss, but this is not true as a breed of sire.

The height at the withers was measured at the same time weights were taken. Withers height is a good measure of scale or size. The big difference was again between beef and dairy as would be expected. However, crossbred calves from dairy cows were taller at birth and at 180 days than the reciprocals from beef cows, but this difference had disappeared by 365 days.

The steers were all slaughtered at the J. Morrell and Co. plant in Estherville, Iowa. The average live weight for 1968 steers was 1048 for farm A and 1068 for farm C. The average age for farm A was 13 months and for farm C was 14.5 months each year. The chilled carcass weight was 616 pounds for farm A and 593 for farm C in 1968 while the two figures for 1969 were 629 and 632. Calves either out of beef sires or dams had a dressing percentage of 59%, while those either out of dairy sires or dams had a dressing percentage of 58%.

Table 7 presents the boneless retail yield as a percent of carcass weight figures using Murphy's equation with

carcass weight, rib eye area, fat over the rib, and estimated percent kidney. Virtually no heterosis exists. Calves from either beef sires or dams had a slightly lower retail yield than those from either dairy sires or dams. Indications are that calves from either the Swiss bull or cow may have a bit more retail yield than those from Holstein.

Table 8 presents the USDA quality grade obtained from the USDA grading service. Heterosis exists for grade in that both the beef-dairy and dairy-beef averaged a low choice grade along with the beef and beef cross calves. Holsteins as a straight breed or in cross combination were slightly superior to the Swiss at this age. These age constant slaughter tests indicate what these breeds and their crosses will do at a given age and can be used to indicate that the dairy blood can be carried to heavier weights without running into carcass fat problems. But at this age the beef-dairy crossbreds will make the choice grade.

Table 7. Boneless Retail Yield in Percent.

Sire <sup>Dam:</sup>	A	H	F	B	:	BS	
A	:	49.7	49.0	49.5	50.3	:	49.6
H	:	49.2	49.9	49.7	50.7	:	49.9
F	:	50.3	50.4	50.9	51.4	:	50.7
B	:	50.7	51.0	51.7	52.2	:	51.4
BD	:	50.0	50.1	50.4	51.1	:	50.4

Table 8. USDA Quality Grade.

Sire <sup>Dam:</sup>		A	H	F	B	:	BS
A	:	AC	LC	LC	LC	:	LC
H	:	LC	LC	LC	HG	:	LC
F	:	LC	LC	HG	HG	:	LC
B	:	LC	LC	AG	AG	:	HG
BD	:	LC	LC	HG	HG	:	LC

AC=average choice, LC=low choice, HG=high good & AG=average good.

Table 9. Fat, Bone, and Lean % in the Round.

Type	Fat	Lean	Bone
Beef & Beef cross	21	63	16
Dairy & Dairy cross	13	67	20

two beef and two dairy breeds as dams. The maternal combining ability was calculated as:

$$MCA_1 = [ \sum_{j=1}^3 Y_{j1} - \sum_{j=1}^3 Y_{1j} ] / 3 .$$

A round from each carcass was separated into fat, lean, and bone at the University meat laboratory. Table 9 gives the percentages of fat, lean and bone found in the beef and beef cross calves and the dairy and dairy cross calves. There was little heterosis; the average of crosses of beef by dairy equaled the straight bred average. At this age, there is a higher percentage of lean in the dairy than in the beef and more bone (20% compared to 16%). The beef rounds contained 8% more fat than those from dairy. The same picture was shown when actual weights were compared using an adjustment for carcass weight.

Discussion

Table 10 is presented as a summary of the beef-dairy single cross steer performance. The values in Table 10 come from the tables previously presented (Tables 4 to 9). The values in Table 10 are unweighted for numbers. The additive values are first presented. They include the straight bred comparisons of dairy versus beef, Hereford versus Angus, and Holstein versus Brown Swiss. Also the general and maternal combining ability comparisons are given. These exclude the straight bred averages. General combining ability was calculated as:

$$GCA_1 = [ \sum_{j=1}^3 Y_{1j} + \frac{1}{3} ( \sum_{j=1}^3 Y_{j1} ) ] / 4$$

where  $Y_{1j}$  = the breed cross average performance in Tables 4 to 9. Calculated this way the GCA of each breed involved These three sorts of additive values reveal some critical aspects of crossing rather divergent breeds. In general,

Table 10. Summary of Beef-Dairy Single Cross Steer Performance.

Item	WEIGHTS			Retail Product	USDA Grade
	Birth	Mid	Year		
ADDITIVE					
Breed Differences:					
Dairy vs Beef :	+21	+120	+164	+1.7	-1.1
Beef H vs A :	+ 9	- 6	+ 21	+ .2	-1.1
Dairy F vs B :	- 2	+ 10	+ 44	-1.3	+ .7
General Combining Ability:					
Dairy vs Beef :	+ 6	+ 15	+ 36	+1.0	- .7
Beef H vs A :	+ 3	+ 1	+ 15	+ .2	- .4
Dairy F vs B :	+ 1	- 1	- 12	- .4	+ .3
Maternal Combining Ability:					
Dairy vs Beef :	+11	+ 82	+ 75	- .8	- .3
Beef H vs A :	+ 1	- 12	- 3	- .3	- .1
Dairy F vs B :	+ 9	+ 25	+ 53	+ .1	0.0
HETEROSIS					
General Heterosis:					
	+ 4	+ 31	+ 61	- .4	+ .4
Specific Heterosis:					
Beef AH :	+ 3	+ 38	+ 59	- .7	+ .1
B x D (A) AF :	+ 5	+ 33	+ 46	- .4	+ .5
AB :	0	+ 30	+ 65	- .4	+ .6
B x D (H) HF :	+ 4	+ 32	+ 56	- .3	+ .6
HB :	+ 1	+ 31	+ 78	- .2	+ .6
Dairy FB :	+ 6	+ 23	+ 60	0.0	+ .2
AVERAGE					
	81	450	943	50.4	11.5

the linear comparison of dairy versus beef accounts for the major portion of breed, general and maternal combining ability differences in growth rate (weights) and carcass traits. Although for mid and yearling weight there are differences between the Hereford and Angus breeds and between the Holstein and Brown Swiss breeds. As a breed the Holstein are 44 pounds superior to the Brown Swiss for yearling weight while for GCA the Brown Swiss are superior but inferior by 53 pounds in maternal combining ability. Dairy breeds and their crosses are superior in growth rate, have a higher percentage of retail product, and grade less than beef breeds.

Table 10 also presents the interaction values or the heterosis both in general and for each specific cross. General heterosis is:

$$GH = \left[ \sum_{i=1}^4 \sum_{j=1, j \neq i}^4 Y_{ij} \right] / 12 - \left[ \sum_{i=1}^4 Y_{ii} \right] / 4 .$$

This gives some idea of the general level of heterosis found when two beef and two dairy breeds are crossed. Relative to the average of the straight breeds there is 5% heterosis for birth weight, 9% for mid weight, 7% for yearling weight, 1% for retail product in the undesirable direction (too much fat), and 4% for USDA quality grade. These levels of heterosis compare favorably with those reported by Cundiff (1970). These steers were on an intensive system (high concentrate) with slaughter at a young age. Less intensive programs that allow slaughter animals to be long yearlings or twos have resulted in less heterosis (Cundiff 1970). Little heterosis has been reported in the literature for retail yield, but crossbreds were fatter. This study agrees well. For USDA grade, few studies report heterosis. However, in this study there is significant heterosis for grade. Half bred beef calves averaged low choice, which is desirable on today's market.

Specific heterosis or that for a particular cross was given by:

$$SH_{ij} = [Y_{ij} + Y_{ji} - Y_{ii} - Y_{jj}] / 2$$

where the  $Y_{ij}$  is a single cross average. From Table 10, the beef by beef and dairy by dairy heterosis can be compared with that from the beef by dairy crosses. If there exists much heterotic advantage in crossing divergent breeds such as beef with dairy breeds it is not evident in these data except for a slight indication in USDA quality grade. Table 11 presents the crossbred and straight bred averages along with the difference and the difference expressed as a percentage for yearling weight. The Angus-Hereford and the Holstein-Brown Swiss crosses exhibit about as much heterosis as do the beef-dairy crosses. This result was not expected. When the breeds are ranked

Table 11. Male Yearling Weight Heterosis.

Cross	CB	SB	H	Z
AH	874	815	59	7
AF	949	903	46	5
AB	946	881	65	7
HF	969	913	56	6
HB	969	891	78	9
FB	1039	979	60	6

by the percentage of heterosis produced in each of three crosses the Hereford and Brown Swiss are tied for first with 7% while the Angus and Holstein average 6+% and 6-% respectively. That the Hereford is superior in combining ability with the breeds it has been crossed with is evidenced in Nebraska, Missouri and Montana data (Cundiff, 1970). In this dairy-beef data the Hereford straight breed average is not questionably low, so this does not account for the ability. However, the Brown Swiss straight breed mean appears to be a bit low in these data making its combining ability a bit questionable.

In these data and in other sets, our predetermined idea of what breeds should be genetically divergent from others may not be correct. In this data one beef and one dairy breed seems superior in their ability to combine well with the other breeds. This same result exists when Charolais are crossed with Hereford and Angus. It is the Hereford that combines well with both the Charolais and Angus.

From Table 10 there is little question that the breeds differ as straightbreds or in crossbred combination when general and maternal combining ability ranks are considered. There are additive differences among the breeds. For this to exist in the cross there must be gene frequency differences among the breeds and the data indicate that the big additive differences are beef versus dairy. Also there are differences within the beef and dairy groups.

It may be that the loci responsible for additive differences show little dominance which would reduce the  $(\Delta p)^2$  term or heterosis in crosses among the "so called" genetically divergent breeds such that the heterosis realized is about the same as in like breeds. Or because of the pedigree barriers that exist for most breeds, the two beef and two dairy breeds may be as divergent genetically from each other as beef and dairy breeds supposedly are.

Kincaid (1962) and later Cundiff (1970) in reviews have indicated that the Brahman by British crosses exhibit heterosis in the order of 10 to 15% which is much more than is currently being realized from temperate zone crossbreeding studies. This large heterosis may be actual genetic divergence between the types of cattle or it may result from neither parent breed being adapted to the coastal region. This earlier information has led many to expect more heterosis from wide crosses in beef cattle. Such seems not to be realized at least in the temperate zone of the United States.

One can speculate that the Hereford color pattern may have tended to keep the breed a bit more isolated than say the Angus breed. Or the Brown Swiss having a bit more combining ability may be explainable on its sheltered origin. But in fact, the differences in heterosis produced by the breeds are not all that big. The interesting thing is that it really is so similar.

Brink *et al.* (1967) and Urick *et al.* (1968) indicate in Hereford line-cross data around 4.5% heterosis for final weight and 5% for weaning weight. This amount of heterosis is not far below that found for breed cross data and in the dairy-beef crosses in these data. Certainly these Hereford lines are less divergent genetically than beef and dairy cattle, but the results do not suggest this.

Taken collectively the published reports on crossbreeding of beef cattle in the temperate zone of the United States and these data on beef-dairy crossbreeding suggest a surprisingly constant amount of heterosis produced regardless of the breeds involved for yearling weight or final weight around a year of age. The breed which seems to combine well in several studies and in this one is the Hereford breed. Breeds do differ in gene frequency since large additive breed effect exist both as purebreds and in cross combination. The Hereford and Angus appear more alike as do the Holstein and Brown Swiss. Yet heterosis amount appears to differ little. The role of epistasis in contributing to heterosis may be involved or the genes which do differ in frequency may be nearly additive in their action.

#### Summary

This study examines the resulting heterosis obtained when crossing two beef and two dairy breeds for intensive beef production. The preliminary results on the production and product traits of steer calves from the first two calf crops of single

crosses are reported. The beef-dairy crossbreeding did not result in larger amounts of heterosis being produced in the beef-dairy crosses than in the beef-beef and dairy-dairy crosses. Relative to the straightbred average there is 5% heterosis for birth weight, 9% for 180 day weight, 7% for yearling weight, 1% for retail product in the undesirable direction (too much fat) and 4% for USDA quality grade. The Hereford and possibly the Brown Swiss breeds combined to produce a bit more heterosis than the other two breeds.

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**STATE REPORTS**

AUBURN UNIVERSITY  
Agricultural Experiment Station

I. PROJECT: Hatch 219 (S-10)

The effect of environment, genetic-environmental interaction and heterosis on performance of beef cattle.

II. OBJECTIVES:

To evaluate the effect of environment and genetic progress under phenotypic selection.

To determine the effectiveness of selection for total performance in beef cattle.

To determine the influence of heterosis on rate of gain carcass quality and cow performance.

III. PERSONNEL:

T. B. Patterson and G. B. Meadows

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work.

The combination of land area, rainfall and long growing season which results in the production of abundant forage, makes the Southeastern United States well adapted to beef production. In order to maximize these natural advantages, there is a definite need for the improvement of the mean performance of beef cattle.

The differential response in various species of animals to their climatic environment has been adequately substantiated. Most of our present breeds of livestock were developed for adaptability to certain environmental conditions as well as to perform specific functions.

Presently beef cattle are being performance tested under specific conditions, while their progeny are expected to perform under a wide range of conditions. In theory, the measurable variance of different traits is composed of variance due to genotype, environment and their interaction. Only change in the additive fraction of the genetic variance results in permanent progress in response to selection. Nevertheless, the magnitude of the environmental and/or genetic-environmental fraction can definitely influence the effectiveness of a selection program. Further, by providing the optimum environment and by taking advantage of genetic-environmental interactions, higher production levels are possible.

There is need for additional research to determine the effectiveness of selection for total performance beef cattle. In essence, information is needed to test whether the apparently large additive genetic variance, as determined by heritability estimates, can actually be exploited in a program of mass selection.

Heterosis is the increased vigor often exhibited by progeny from the mating of two distinct families, breeds or species. Livestock do not possess, to an equal degree, the adaptability of plants to a breeding program that permits maximum utilization of hybrid vigor. Nevertheless, the superior performance of breed crosses of swine indicates the need for additional research to determine the value of such a breeding method with beef cattle. This is particularly true with reference to the effect of heterosis on mothering ability and on progeny from a continuous cross-breeding program.

Purebred herds of the Angus and Hereford breeds located at the Beef Cattle Research Unit, Auburn University, provided the foundation stocks for this study. Each breed was divided into high and low performance groups based initially on previous record, where available, and on a performance index where previous record was not available. These groups were subdivided into two equal groups, again based on previous record or index. Thus, there are two high and two low performance groups for each breed. This makes a total of eight herds. One high and one low performance herd of each breed was assigned to each of two nutritional regimes.

Winter feeding levels are the same for all eight herds. However, the high nutritional groups are placed on the best legume pastures in the spring while the low nutritional groups remain on silage until grass pastures are available. In addition, the calves in the high nutritional groups are given access to a creep feed which is high in protein and low in carbohydrates. No other environmental differences are imposed on the two nutritional groups.

After weaning, all cows are subjected to similar management conditions. All calves are handled alike on postweaning test. Replacements are selected by index within groups.

Data collection include birth weight, weaning weight (250 day) weaning score, finish score, ultrasonic fat thickness, postweaning gain (140 days for bulls and 120 days for heifers), final score, final finish score, final ultrasonic fat thickness and weight of bulls at  $400 \pm 15$  days.

Cows produced in a previous crossbreeding study have been used to study the effect of heterosis on mothering ability in beef cows. These cows include purebred Angus, Hereford and Shorthorn cows bred to produce two-breed cross calves and two-breed cross bred cows from among the same breeds bred to the third breed to produce three-breed cross calves. Thus, comparisons are made between two-breed cross calves nursing purebred cows and three-breed cross calves nursing crossbred cows. Pre- and postweaned performance data were obtained on all calves. In addition, all steer calves were slaughtered and complete carcass information obtained.

## 2. Research results.

Four calf crops have been carried through post-weaning performance. These data have been summarized in the appendix tables. A comparison of the effects of high and low pre-weaning nutritional level on performance of bulls and heifers are shown in Tables 1 and 2. The high nutrition calves for both breeds and for both sexes weaned heavier than the low nutrition calves. As expected, compensatory gain occurred without exception in the

post-weaning test period. However, at the end of the post-weaning period the high nutrition calves averaged 0.10 lbs. per day (WDA) more than did the low nutrition calves. Small differences in conformation score favored the high nutrition calves.

A comparison of calves from high and low genetic parents is summarized in Tables 3 and 4. With one exception, weaning weight for low Hereford bulls compared to high Hereford bulls, Table 3, all high genetic calves were heavier at weaning, gained faster post-weaning, had a higher WDA and had slightly higher conformation scores than did the low genetic calves. Contrast these results with the nutritional effects, where compensatory gain occurred after the proper nutritional level was supplied.

Of continued interest is the effect of pre-weaning nutritional level on reproductive performance as two and three year olds which is summarized in Table 5. It is possible that many of the smaller heifers on low pre-weaning nutrition had not reached puberty by the end of the 70-day breeding season thus accounting for the lower calving rate. The large difference in per cent of heifers that calved as two year olds that also calved as three year olds apparently is a carry over effect of smaller size associated with pre-weaning nutritional level.

Calves on the high nutrition level gained faster from birth to weaning while the calves on the low nutrition level gained faster post-weaning. However, WDA favored the high level calves at the end of test. Replacement females from the high level groups had higher reproduction rates at two and three years of age. The calves from high genetic parents grew faster both pre- and post-weaning than did calves from low genetic parents. These differences in weaning weights and post-weaning gains were not as great as were those between the nutritional groups.

Table 1. The effect of pre-weaning nutrition level on the performance of bull calves. Four year average.

Breed	Angus		Hereford	
	High	Low	High	Low
Number of bulls	60	51	68	57
Av. adjusted weaning wt., lbs.	562	518	540	485
Av. post-weaning ADG., lbs.	2.53	2.78	2.48	2.56
Av. final WDA, lbs.	2.35	2.29	2.27	2.14
Av. final conf. score	13.30	12.90	13.30	12.70

Table 2. The effect of pre-weaning nutrition level on the performance of heifer calves. Four year average.

Breed	Angus		Hereford	
	High	Low	High	Low
Number of heifers	68	78	53	68
Av. adjusted weaning wt., lbs.	545	492	545	480
Av. post-weaning ADG., lbs.	1.10	1.18	0.80	0.88
Av. final WDA, lbs.	1.57	1.48	1.47	1.36
Av. final conf. score	13.00	12.90	12.80	12.40

Table 3. The effect of high and low genetic parents on the performance of bull calves. Four year average.

Breed Genetic level	Angus		Hereford	
	High	Low	High	Low
Number of bulls	61	50	57	68
Av. adjusted weaning wt., lbs.	547	536	532	501
Av. post-weaning ADG., lbs.	2.69	2.59	2.50	2.53
Av. final WDA., lbs.	2.34	2.29	2.24	2.18
Av. final conf. score	13.20	13.00	13.10	13.00

Table 4. The effect of high and low genetic parents on the performance of heifer calves. Four year average.

Breed Genetic level	Angus		Hereford	
	High	Low	High	Low
Number of heifers	74	72	63	58
Av. adjusted weaning wt., lbs.	523	510	512	505
Av. post-weaning ADG., lbs.	1.19	1.09	0.88	0.80
Av. final WDA, lbs.	1.56	1.48	1.43	1.38
Av. final conf. score	13.00	12.80	12.60	12.50

Table 5. The effect of high and low pre-weaning nutrition level of the reproductive performance of two and three year old females. Three year average.

Nutrition level	High	Low
Per cent calving at two years	84.0 (63/75)	72.0 (59/82)
Per cent born dead	15.9 (10/63)	16.9 (10/59)
Per cent calving at two that calved at three years	95.5 (42/44)	79.2 (38/48)

#### V. FUTURE PLANS:

The project will be continued as outlined.

#### VI. PUBLICATIONS DURING THE YEAR:

Patterson, T. B., Crossbreeding among the British breeds of beef cattle.  
Proceedings 1971 Beef Cattle Short Course, Auburn University.

Patterson, T. B., The evaluation of carcasses produced from crossbred steers.  
Proceedings 1971 Beef Cattle Short Course, Auburn University.

#### VII. PUBLICATIONS PLANNED:

Experiment Station Bulletin, "Crossbreeding among the British breeds of beef cattle."

I. PROJECT: Animal Science 4-016

A comparison of crossbreeding and within breed selection on beef cattle production in the Black Belt Area of Alabama.

II. OBJECTIVES:

To evaluate the significance of hybrid vigor in various crosses of beef cattle with regard to production of slaughter calves, stocker or feeder steers and slaughter steers.

To determine the effect of heterosis on mothering ability adaptability and fertility.

III. PERSONNEL:

Troy B. Patterson, L. A. Smith and Harold Grimes

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work.

Few crossbreeding studies have furnished adequate results with reference to: (1) Mothering ability of breeds and their crosses, (2) The relative merits of various breed crosses for slaughter calves, stocker calves and slaughter steers, (3) The performance of second, third and subsequent generation crosses of British x Brahman and crosses among the British breeds, (4) The application of these results to a practical breeding program. Recent increases in production costs and lower prices received for cattle have resulted in many beef producers making little, if any, net profit. Obviously, these producers must either cut expenses and become more efficient or increase production per brood cow with little interest in cost of operation.

The breeding and forage programs at the Black Belt Substation have been adequate to consistently produce calves that wean at over 500 pounds. The steer calves have reached the acceptable market weight of 1000 pounds at approximately 15 months of age. However, comparisons between established crossbreds and those with Charolais breeding would indicate potential for improvement. In addition, the better performing crossbreds have not produced more desirable carcasses from the standpoint of ratio of fat to lean and cutability (as determined by yield grade). Improvement in this respect due to breed composition appears possible.

Mature Hereford and 1/2 Angus - 1/2 Hereford crossbred cows were divided into similar groups based on breed. One group was bred to a Hereford bull and the other group to a Charolais bull. Cows are rotated each year to minimize cow differences between groups. Four groups of calves are produced each year, namely (1) Hereford, (2) 3/4 Hereford - 1/4 Angus, (3) 1/2 Charolais - 1/2 Hereford and (4) 1/2 Charolais - 1/4 Hereford - 1/4 Angus. These calves are born, for the most part, in late fall and early winter.

One Hereford bull and one Charolais bull were used for two consecutive years. Groups of cows were reversed by breed of bulls for the second year. At the end of the second season, all cows were re-allotted and two new bulls obtained.

All calves are creeped until pasture is available in the spring. Additional creep is used only when pasture conditions are such that supplemental feeding becomes necessary to maintain normal growth. Environmental differences between groups are minimized by pasture rotation on a regular basis.

Weaning weights, slaughter and feeder grades are recorded. An estimated market value is obtained at weaning by an experienced local cattle buyer.

At weaning the steer calves go directly to the feed lot where they are fed by breed groups to an average shrunk weight of approximately 1000 pounds. The steers are marketed by breeding groups as they reach the desired weight. Data collected includes feed lot gain, feed efficiency, complete slaughter data and a tenderness evaluation based on samples from a two inch rib section from the left side taken at the 12th rib of each carcass.

## 2. Research results.

Three calf crops have been weaned and the steers from the second finished in the feed lot and carcass data obtained. The per cent calf crop weaned and weaning weights and grades are shown in Table 1. The first Charolais bull used was crippled. The second was not sexually mature at 2 years and had to be replaced. Thus most of the difference in per cent calf crop. Nevertheless the effect is great as indicated by pounds of calf weaned per cow bred. The differences in average weaning weight favors the Charolais sired calves by approximately 90 pounds.

Feed lot performance is summarized in Table 2. The Charolais sired calves grew faster in the feed lot, were heavier at the end of the feed lot period by 124 pounds, had higher weight per day of age, and required on the average only 34 pounds more feed per cwt. gain despite the heavier weight and therefore more maintenance requirements.

Carcass data are summarized in Table 3. The Charolais sired steer carcasses excelled the Hereford sired steer carcasses in: (1) Hot carcass weight, (2) Carcass WDA, (3) Ribeye per cwt. carcass, (4) Backfat thickness, (5) Yield grade and (6) Quality grade.

Based on the limited sample of this study, Charolais bulls do not settle cows as well as do Hereford bulls. However, Charolais sired calves grow faster and produce more desirable carcasses than do calves sired by Hereford bulls.

Table 1. Per cent calf crop weaned, weaning weights, weaning grades and pounds of calf weaned per cow bred. Three year average.

Breed of bulls	Hereford	Hereford	Charolais	Charolais
	Hereford	1/2 Hereford	Hereford	1/2 Hereford
Breed of cows		1/2 Angus		1/2 Angus
Per cent weaned calf	86.0	93.7	70.5	75.2
Av. adj. weaning wt., lbs.	564	597	661	681
Av. lbs. calf per cow bred	485	560	466	512
Av. stocker grade	13.6	13.7	14.3	14.4

Table 2. Feed lot performance. Two year average.

	Breeding of steers			
	Hereford	3/4 Hereford 1/4 Angus	1/2 Charolais 1/2 Hereford	1/2 Charolais 1/4 Angus 1/4 Hereford
No. of steers	11	11	12	12
Av. days on feed	154	161	166	154
Av. final wt., lbs.	998	1028	1148	1126
Av. daily gain, lbs.	2.49	2.56	2.91	2.73
Av. WDA, lbs.	2.42	2.44	2.70	2.70
Av. feed/cwt. gain, lbs.	904	890	863	1000
Av. final grade	13.1	13.7	12.6	12.3

Table 3. Carcass data. Two year average.

	Breeding of steers			
	Hereford	3/4 Hereford 1/4 Angus	1/2 Charolais 1/2 Hereford	1/2 Charolais 1/4 Angus 1/4 Hereford
Av. hot carcass wt., lbs.	585	602	688	684
Av. carcass WDA, lbs.	1.40	1.45	1.42	1.65
Av. Ribeye/cwt. carcass, sq. in.	2.04	2.20	2.48	2.48
Av. back fat/cwt. carcass, in.	0.10	0.11	0.05	0.06
Av. yield grade	3.30	3.50	2.50	2.60
Av. quality grade	11.80	12.80	12.50	12.80

## V. FUTURE PLANS:

Continue as outlined.

## VI. PUBLICATIONS DURING THE YEAR:

None

## VII. PUBLICATIONS PLANNED:

Crossbreeding beef cattle in the Black Belt Area of Alabama

I. PROJECT: Animal Science 4-017

The effects of breed and breed crosses on milk production and on other production factors in a grade beef herd.

II. OBJECTIVES:

To determine the effect of Brown Swiss, Holstein and Charolais, breeding on (a) milk production, (b) weaning weights and grades, (c) feedlot performance, and (d) carcass desirability.

III. PERSONNEL:

T. B. Patterson and R. A. Moore

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work.

Many of the commercial beef herds in the Southeast were established with common cows of predominantly dairy breeding as foundation females. Purebred beef bulls were used in a grading up process. Most of the build up in numbers and subsequent grading up process occurred within the past 15-20 years when market price and demand favored a so called "milk fat calf." Consumer preference has changed over the past five to ten years to a demand for heavier beef. Nevertheless, most commercial producers in Alabama still market their calves at weaning, and total weight and price per cwt. determine gross receipts.

In the opinion of many commercial breeders there is an apparent reduction of milking abilities of brood cows associated with the grading up process. Milk is the most important source of quality nutrients in the diet of the beef calf. Producers are faced with the choice of reverting to the original type cows that are often lacking in beef conformation and/or inherent ability to gain, or attempting to improve milk production within the existing herd through phenotypic selection. Obviously, improvement in milk production can be accomplished most rapidly through the use of selected sires since a sire constitutes roughly one-half of the genetic make-up of the herd.

Seventy-five grade beef cows were divided into similar groups of 25 each on the basis of age, breeding, and previous production record each year. They were bred to Hereford (control), Brown Swiss and Charolais bulls. The bulls were changed each year. A group of Holstein and Holstein-Jersey cows were bred to the Hereford bulls.

Additional information such as milk production of the original cows at 90 and 250 days of lactation was established. Production information on all calves to weaning can be related to milk production of their dams. Postweaning performance and carcass data on all steer calves provided information on the effects of breeding on production.

All physically sound heifers produced by the procedure described above have been retained until approximately 25 breeding age females per breeding group were available. These heifers were bred to closely related Hereford bulls

selected from a high producing herd. Only bulls with above average weaned weights were considered. Milk production obtained from this set of females will provide a comparison with the original and with subsequent herd milk production levels. Milk production and breed of dam is confounded; however, differences in calf weaned weights reflects these two important brood cow characteristics.

All steer calves are full fed on corn silage plus supplement until they have reached 1,000 pounds and average in the choice grade. Carcass data are obtained on all steers. As before all physically sound heifers are retained as replacements for the next generation.

## 2. Research results.

Three calf crops have been produced out of the four groups of first generation cows. The steers from the first two calf crops were fed out in the feed lot and slaughtered. Replacement females have been retained as second generation cows. These cows have produced their first calf crop sired by the second set of Hereford bulls.

Reproductive performance and birth weights for the first three years are shown in Table 1. The Brown Swiss cross cows produced the highest per cent calf crop. Birth weights were heavier for calves out of the crossbred cows with the larger cows usually producing the larger calves.

Weaning weights and grades for the first three years are summarized in Table 2. Adjusted weaning weights of all crossbred calves were heavier than the Hereford control calves. Among the crossbred calves the Brown Swiss cross calves were heavier followed by the Holstein and Charolais cross in that order. There were no differences in weaning grades.

All calves remained on their dams for approximately 60 days after 250 day weights were obtained. The steer calves were fed out in dry lot on a ration consisting of a full feed of corn silage and a limited amount of supplement. These data are summarized in Table 3. The Brown Swiss and Holstein cross steers gained faster than the straight Hereford and Charolais cross steers. However, all three groups of cross steers were significantly heavier at the end of the feed lot period than the Hereford steers. Final live grades favored the Hereford and Holstein cross steers.

Carcass data for the two years are shown in Table 4. The three cross groups of steers had heavier carcasses than did the Hereford controls with the Holstein cross being the heaviest. There were no differences in carcass quality grades with all breeding groups averaging low choice. The Charolais cross carcasses had less fat, larger ribeye areas and better yield grades. There were no differences in these traits among the other three breeding groups.

Milk production for the first generation cows was obtained during the year. The results are summarized and compared to the foundation cows in Table 5. An overall improvement in milk production is evident when foundation cows are compared to first generation cows. These differences would have been greater and less difference in winter and summer in milkings had the first generation cows been mature. All foundation cows were mature at the time they were milked, while 12 of the first generation cows were 3 year olds and 17 were 4 year olds when they were milked.

Calves out of crossbred cows were significantly heavier at weaning and the steers were significantly heavier at slaughter than were those out of Hereford cows. Carcasses from the cross steers were heavier but there were no differences in quality grade. The Charolais cross steers produced carcasses that were leaner and had better yield grades. Milk production was significantly higher in the first generation cows when compared to the foundation cows.

Table 1. Reproduction and birth weights for first generation Hereford and Hereford backcross cows. Three year average.

	Breeding of cows			
	Hereford Control	1/2 Hereford 1/2 Charolais	1/2 Hereford 1/2 Brown Swiss	1/2 Hereford 1/2 Holstein
No. of cows exposed	61	68	55	65
Per cent calf crop weaned	75.4	79.4	89.1	75.4
Av. birth wt., lbs.	62.5	65.9	67.3	70.3

Table 2. Weaning weights and grades for calves from first generation cows. Three year average.

	Breeding of calves			
	Hereford Control	3/4 Hereford 1/4 Charolais	3/4 Hereford 1/4 Brown Swiss	3/4 Hereford 1/4 Holstein
No. of calves	46	54	49	49
Av. adj. weaning wt., lbs.	470	538	572	559
Av. feeder grade	12.5	12.8	12.1	12.6

Table 3. Feed lot performance of steers from first generation cows. Two year average.

	Breeding of steers			
	Hereford Control	3/4 Hereford 1/4 Charolais	3/4 Hereford 1/4 Brown Swiss	3/4 Hereford 1/4 Holstein
No. of steers	19	20	16	17
Av. initial wt., lbs.	545	593	597	624
Av. feed lot ADG., lbs. (235 days)	1.75	1.74	1.81	1.86
Final shrunk wt., lbs.	956	1001	1022	1052
Final grade	12.50	11.20	11.50	12.20

Table 4. Carcass data of steers from first generation cows. Two year average.

	Breeding of steers			
	Hereford Control	3/4 Hereford 1/4 Charolais	3/4 Hereford 1/4 Brown Swiss	3/4 Hereford 1/4 Holstein
No. of steers	19	20	16	17
Av. hot carcass wt., lbs.	574	604	608	636
Av. carcass WDA, lbs.	1.08	1.15	1.14	1.21
Av. rib fat, ins.	0.44	0.30	0.40	0.41
Av. ribeye area, sq. ins.	10.45	11.29	10.76	10.68
Av. quality grade	12.30	12.10	12.30	12.60
Av. yield grade	3.10	2.60	3.00	3.20

Table 5. Twelve hour milk production for foundation and first generation cows.

Breeding group	No. of Cows	Winter <sup>1</sup> milking lbs.	Summer <sup>2</sup> milking lbs.
Foundation Herefords	66	4.66	4.47
First Generation	71	7.54	5.27
Hereford	14	5.75	3.29
Charolais cross	20	7.11	4.82
Brown Swiss cross	21	7.43	6.57
Holstein cross	16	9.62	5.81

<sup>1</sup> Milked when calves were approximately 90 days of age.<sup>2</sup> Milked just prior to weaning when calves were approximately 250 days of age.

## V. FUTURE PLANS:

The project will be continued as outlined.

## VI. PUBLICATIONS DURING THE YEAR:

None

## VII. PUBLICATIONS PLANNED:

A popular type report on the first phase of this study.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Alabama

Location		Auburn	Auburn	Auburn	Auburn	
Breed of sire		Angus	Angus	Angus	Angus	
Breed of dam		Angus	Angus	Angus	Angus	
Line or group <sup>1</sup>		EIGI	EIGII	EIIGI	EIIGII	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	35	33	36	37	
	Yearling Heifers	7	8	8	9	
	Bulls and steers under 1 year	17	18	10	15	
	Heifers under 1 year	14	7	18	17	
	Bulls over 1 year	2	2	2	2	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant <sup>2</sup>	94.7	80.0	78.4	86.8	
	Calf survival <sup>3</sup> percent	86.1	89.3	100.0	97.0	
Wean. perf.	Adj. ADG <sup>4</sup>	1.98	1.86	1.76	1.78	
	Av. type score <sup>5</sup>	13.3	13.0	12.9	12.7	
Postweaning performance	No. of bulls	10	8	10	8	
	No. of heifers	8	8	6	12	
	No. of steers	3	4	3	2	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	3	4	3	2	
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: (To steer and mature dam).

5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Alabama

Location		Auburn	Auburn	Auburn	Auburn	
Breed of sire		Hereford	Hereford	Hereford	Hereford	
Breed of dam		Hereford	Hereford	Hereford	Hereford	
Line or group <sup>1</sup>		EIGI	EIGII	EIIGI	EIIGII	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	33	29	34	32	
	Yearling Heifers	9	5	5	7	
	Bulls and steers under 1 year	14	8	16	13	
	Heifers under 1 year	16	13	11	12	
	Bulls over 1 year	2	2	2	2	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant <sup>2</sup>	93.9	87.1	83.8	87.5	
	Calf survival <sup>3</sup> percent	93.5	81.5	90.3	92.8	
Wean. perf.	Adj. ADG <sup>4</sup>	1.96	1.88	1.58	1.59	
	Av. type score <sup>5</sup>	13.0	12.7	12.5	12.7	
Postweaning performance	No. of bulls	5	13	7	6	
	No. of heifers	12	5	8	12	
	No. of steers	2	2	3	3	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	2	2	3	3	
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: (To steer and mature dam).

5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Alabama

Location		BBS\$ Marion Jct.	BBSS Marion Jct.	BBSS Marion Jct.	BBSS Marion Jct.	
Breed of sire		Hereford	Hereford	Hereford	Hereford	
Breed of dam		Hereford	$\frac{1}{2}$ Angus $\frac{1}{2}$ Hereford	Hereford	$\frac{1}{2}$ Angus $\frac{1}{2}$ Hereford	
Line or group <sup>1</sup>		Grade	Crossbred	Crossbred	Crossbred	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	11	11	10	18	
	Yearling Heifers	5	6	2	4	
	Bulls and steers under 1 year	4	5	7	7	
	Heifers under 1 year	6	5	1	7	
	Bulls over 1 year	1	0	1	0	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant <sup>2</sup>	90.9	100.0	80.0	83.3	
	Calf survival <sup>3</sup> percent	100.0	90.9	100.0	93.3	
Wean. perf.	Adj. ADG <sup>4</sup>	1.95	2.14	2.41	2.43	
	Av. type score <sup>5</sup>	13.6	13.7	14.6	14.5	
Postweaning performance	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	6	10	5	3	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	6	10	5	3	
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: (To steer and mature dam).

5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Alabama

Location		UCPSS Winfield	UCPSS Winfield	UCPSS Winfield	UCPSS Winfield
Breed of sire		Hereford	Hereford	Hereford	Hereford
Breed of dam		Hereford	$\frac{1}{2}$ Hereford $\frac{1}{2}$ Charolais	$\frac{1}{2}$ Hereford $\frac{1}{2}$ Brown S.	$\frac{1}{2}$ Hereford $\frac{1}{2}$ Holstein
Line or group <sup>1</sup>		Grade	Crossbred	Crossbred	Crossbred
Percent used in project		100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	19	24	28	21
	Yearling Heifers	7	10	10	3
	Bulls and steers under 1 year	6	13	10	8
	Heifers under 1 year	10	7	15	11
	Bulls over 1 year	6	0	0	0
	Steers over 1 year	0	0	0	0
Repro. perf.	Percent pregnant <sup>2</sup>	89.5	87.5	92.9	95.2
	Calf survival <sup>3</sup> percent	94.1	95.2	96.2	95.0
Wean. perf.	Adj. ADG <sup>4</sup>	1.64	1.90	2.08	1.98
	Av. type score <sup>5</sup>	12.3	12.8	12.3	13.0
Postweaning performance	No. of bulls	0	0	0	0
	No. of heifers	0	0	0	0
	No. of steers	7	10	11	12
Slaughtered	No. of bulls	0	0	0	0
	No. of heifers	0	0	0	0
	No. of steers	7	10	11	12
Remarks:					

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: (To steer and mature dam).

5 - Suggest S-10 scoring system; indicate if different.

UNIVERSITY OF ARKANSAS  
Agricultural Experiment Station  
Fayetteville, Arkansas

I. PROJECT: Hatch 170

Evaluation of performance records of beef cattle.

II. OBJECTIVES:

Continue to develop practical but adequate methods for identifying, evaluating and propagating the genetic potential for the production of beef.

III. PERSONNEL:

C. J. Brown, J. E. Brown, R. S. Honea and L. O. Brown

IV. ACCOMPLISHMENTS DURING THE YEAR:

At the Main Experiment Station, purebred herds of Angus, Hereford and Polled Hereford herds as indicated in the project outline and inventory were made. Preweaning and postweaning growth and related information were recorded on males and females. Bulls were individually fed and females were group fed on pasture.

At the Main Experiment Station, the third year of a four year experiment in which Hereford, Angus, Charolais and Santa Gertrudis bulls were mated to Hereford and Angus cows was completed. Steers were fed to 1000 pounds weight and carcass data obtained. Heifers were bred to calve as soon as possible to assess reproductive potential of the various crosses. A three year summary accompanies.

At the Pinetree Land Use Project, a crossbreeding study in which Hereford, Angus and Hereford x Angus females will be mated to Charolais and Santa Gertrudis bulls will be initiated this year. This study will permit comparison of straightbred, single cross and three-way crosses involving these breeds. At this station, Red Poll x Hereford, Red Poll x Angus, B. Swiss x Hereford, B. Swiss x Angus criss cross matings have been made and are intended with Holstein x Hereford, Holstein x Angus, Jersey x Hereford and Jersey x Angus.

From the data accumulated in the purebred herds between 1950-1967, lifetime weight-age curves were computed for 288 Hereford and 296 Angus females and 26 herd sires. The equation  $y_{it} = A_i (1 - B_i e^{-Kt}) + e_{ijt}$  described by Brody (1945) was used to determine the weight-age curve of each individual. Genetic and environmental relationships among growth curve characteristics and various measures of development have been studied.

V. PUBLICATIONS:

Brown, C. J. 1971. Some considerations of size as related to herd efficiency. Angus Journal, July.

Brown, C. J. and J. E. Brown. 1971. The influence of development pattern on maintenance costs of beef cows. Rpt. of 7th Annual Ark. Agri. Sci. Res. Conf. pp. 17-20.

- Brown, C. J., Carl Lueker and Lans O. Brown. 1970. Performance of bulls on Arkansas Cooperative Beef Bull Performance Test #8. Ark. Expt. Sta. Rpt. Series 188.
- Brown, C. J. and O. T. Stallcup. 1971. Histological evidence of sexual maturity in beef bulls. Ark. Farm Research 20:14.
- Brown, J. E., C. J. Brown and W. T. Butts. 1971. A discussion of the genetic aspects of weight, mature weight and rate of maturing in Hereford and Angus cattle. (Manuscript submitted to J. Animal Sci.)
- Brown, J. E., C. J. Brown and W. T. Butts. 1971. Relationships among weights, gains and rate of maturing in cattle. (Manuscript submitted to J. Animal Sci.)
- Brown, J. E., C. J. Brown and R. S. Honea. 1971. Earliness of maturing and its relationship to gain and mature weight in Hereford and Angus females. Rpt. of 7th Annual Ark. Agri. Sci. Res. Conf. pp. 13-16.
- Wingert, Stanley J. 1970. Some genetic aspects of the growth curves of Angus cows. M.S. Thesis, U. of A. Library.
- Wingert, Stanley J., Zelpha Johnson- James E. Brown and C. J. Brown. 1971. The effect of weight interval on estimation of growth constants and related production measures. J. Animal Sci. 32:396 (Abstr.).

Table 1. Birth Weights and 210-Day Weights Adjusted  
To a Steer Basis from a Mature Dam

Dams		Sires			
		A	H	S	C
A	Birth Weight	61	66	70	75
	210-Day Weight	444	449	496	479
H	Birth Weight	66	68	73	77
	210-Day Weight	452	421	465	461

Table 2. Superiority of Crossbred Calves Over  
Straightbred Calves

	Angus		Hereford	
	Pounds	%	Pounds	%
AH	8	1.8	31	7.3
HA	5	1.1	28	6.6
SA	52	11.7	75	17.8
SH	21	4.7	44	10.4
CA	35	7.5	50	11.9
CH	27	6.1	40	9.5

## INFLUENCE OF DEVELOPMENT PATTERN ON GROWTH AND MAINTENANCE COSTS OF BEEF COWS

C. J. Brown and J. E. Brown

In recent years, much emphasis in beef cattle breeding programs has been directed toward increasing weight for age. Heavier weights at immature ages are generally accepted in the industry as being desirable. A related discussion concerns the most desirable size of cow for producing market-weight steers with the most rapid growth rate and most desirable carcass. Neglected in such discussions are the relevant questions concerning costs of cow maintenance.

Evaluating cow maintenance costs is difficult and expensive to do directly. However, lifetime weight-age curves developed in some of our recent research have been used to indirectly estimate energy requirements for maintenance. This article illustrates how different development patterns of cows may influence production costs.

Four cows having different patterns of development were chosen for the illustration. In the first comparison (Figure 1) two cows of nearly the same mature weight but with different rates of maturity are shown. The second graph (Figure 2) compares two cows with different mature weights and different rates of maturity.

Different development patterns such as illustrated here result in different energy requirements, which may be estimated from equations used by the National Research Council to determine energy requirements for beef cattle (NRC 1970, No. 4). The equations estimate net energy for maintenance,  $NE_m = W^{0.75}$ , and net energy for gain,  $NE_g = (0.05603 \text{ gain} + 0.01265 \text{ gain}^2) W^{0.75}$ .

Energy requirements for maintenance and growth were calculated on a daily basis and accumulated to arrive at the total energy requirement of the different ages and weights. The approximate cost of a Megacalori of net energy (approximately 1 pound of TDN) was set at 3 cents, based on the price of corn.

In the table, the comparison of cows 1 and 2, with nearly the same mature weight, illustrates the difference in maintenance costs that can result from different rates of maturity. Note that the earlier-maturing cow cost more to maintain at all ages up to 5 years, where there was a cumulative difference of \$68 in cost of development in favor of the slower-maturing cow. However, the cost to reach a given weight was greater for the slower-maturing cow at all weights. The annual cost of maintenance of these two cows after they reach maturity would be similar but, during the period of development, cumulative maintenance costs differ greatly because of different rates of maturity.

Comparison of cows 3 and 4 provides a contrast in the cost of development. Cow 3 is an early-maturing cow of low mature weight; cow 4 is a late-maturing cow with high mature weight. At all ages up to 5 years, cow 3 had greater cumulative costs of development, but at all weights, cow 4 had greater cumulative costs. At 5 years, the smaller cow 3 had cost \$34 more to develop because of her more rapid early development. However, at maturity, the annual cost of maintenance was \$24 per year more for the heavier cow 4.

These indirect estimates of growth and maintenance costs for the growth patterns commonly found in today's beef cattle populations suggest that when breeders evaluate the total efficiency of an individual or a herd under a given set of circumstances they should give greater consideration to input costs that are associated with size.

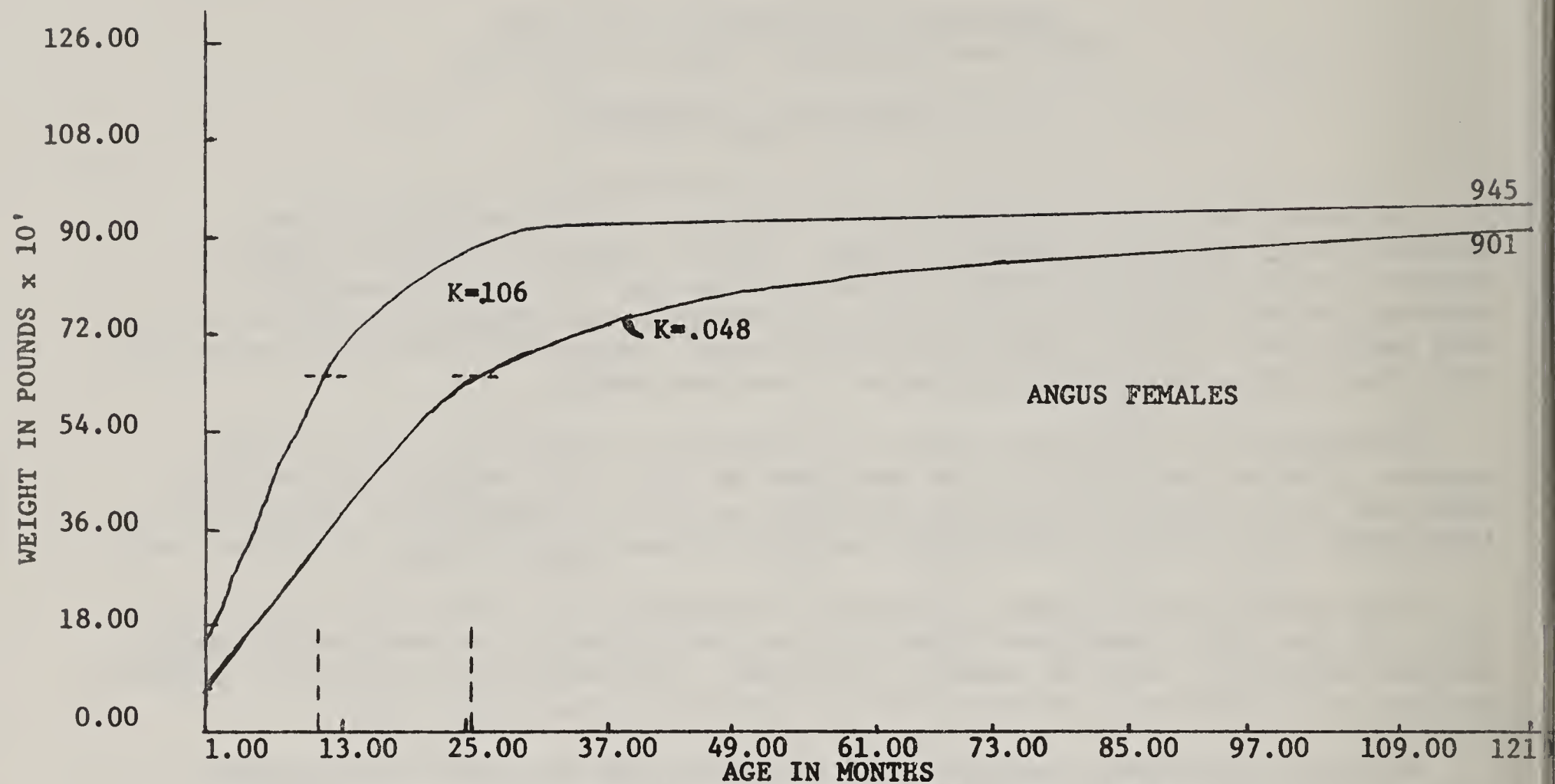


Fig. 1. Development patterns of cows with same mature weights.

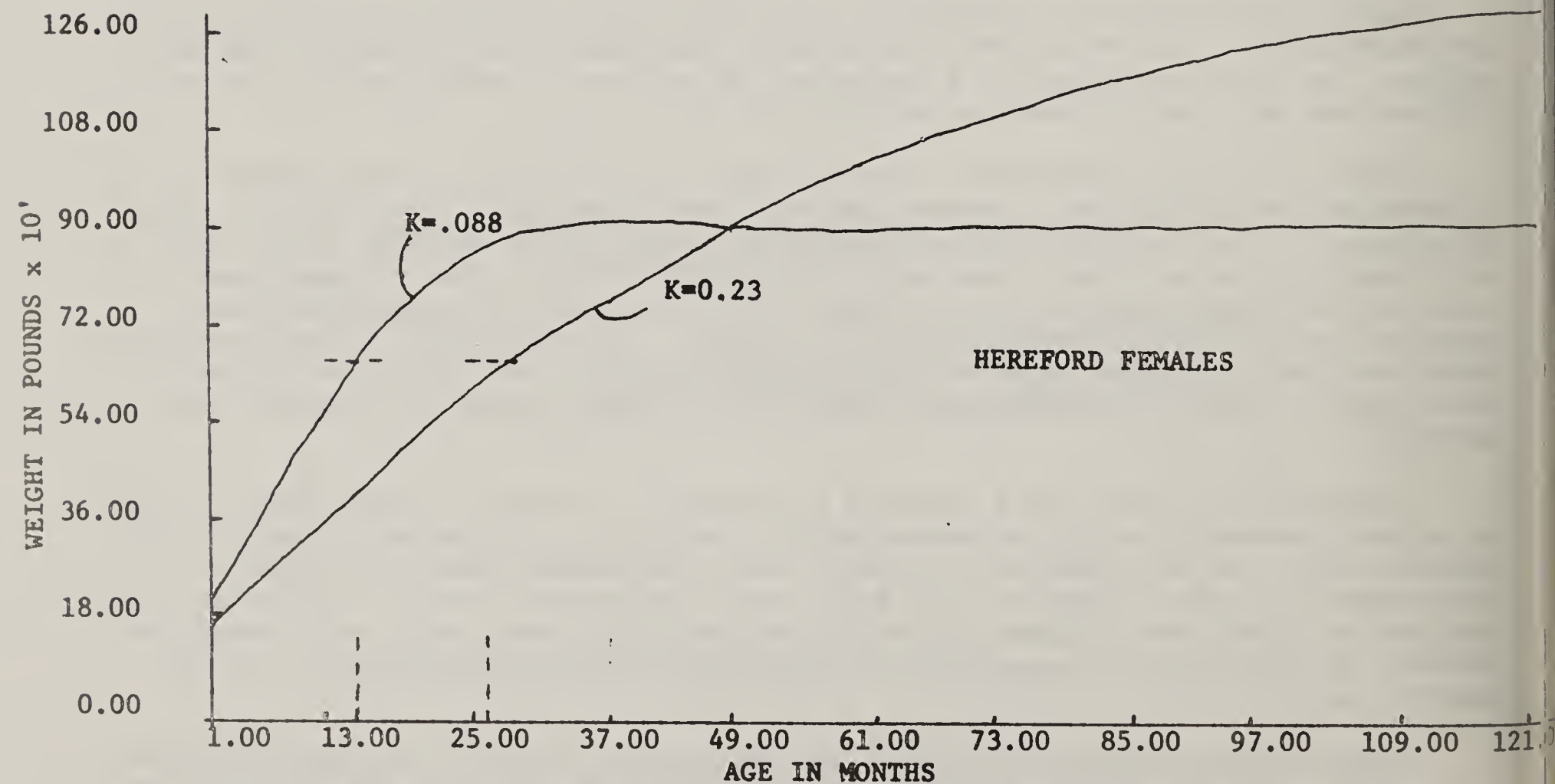


Fig. 2. Development patterns of cows with different mature weights.

Estimates of Growth and Maintenance Costs for Cows Having Different  
Patterns of Development

Cost comparisons (dollars)											
Cow no.	Mature wt. (lb)	Rate of maturing	Constant ages (yr)					Constant Weights			Yr. main. at mat.
			1	2	3	4	5	400#	600#	800#	
1	945	.1060	70	151	230	309	387	21	49	105	78.84
2	901	.0484	41	102	172	245	319	34	87	218	77.00
3	893	.0885	60	134	212	288	365	24	58	138	76.00
4	1292	.0230	36	94	166	246	331	40	94	184	100.40

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Arkansas

		A	H	CROSS		
Location		Main Station	Main Station	Main Station		
Breed of sire		Angus	Hereford	H x A x Ch x St.G		
Breed of dam		Angus	Hereford	H x A		
Line or group <sup>1</sup>		Purebred	Purebred	Crossbred		
Percent used in project		100	100	100		
Inventory as of July 1, 1970	Cows 2 years and over	203	91	62		
	Yearling Heifers	43	35	6		
	Bulls and steers under 1 year	61	45	29		
	Heifers under 1 year	73	47	25		
	Bulls over 1 year	57	28	0		
	Steers over 1 year	3	0	36		
Repro. perf.	Percent pregnant <sup>2</sup>	79	92	76		
	Calf survival <sup>3</sup> percent	88	87	95		
Wean. perf.	Adj. ADG <sup>4</sup>	1.8	1.7	1.9		
	Av. type score <sup>5</sup>	12.7	12.5	12.1		
Postweaning performance	No. of bulls	53	26	2		
	No. of heifers	0	0	0		
	No. of steers	6	0	0		
Slaughtered	No. of bulls	30	11	0		
	No. of heifers	0	0	0		
	No. of steers	6	0	38		
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.  
 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.  
 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.  
 4 - Indicate adjustments:  
 5 - Suggest S-10 scoring system; indicate if different.

UNIVERSITY OF FLORIDA  
Agricultural Experiment Station  
Gainesville, Florida

I. PROJECT: 627

Pasture programs and cattle breeding systems for beef production on flatwoods soils of Northcentral Florida.

II. OBJECTIVES:

1. To determine the relative cost of three pasture programs for beef production with a cow-calf operation.
2. To compare the effectiveness of four different breeding systems in improving the production of beef cattle.
3. To evaluate systems for growing heavy calves to market weight and grade.

III. PERSONNEL:

M. Koger, W. G. Blue, G. B. Killinger, J. M. Myers and R. E. L. Greene

IV. ACCOMPLISHMENTS DURING THE YEAR:

Two hundred forty-seven females of breeding age were used during 1968-1969 in evaluating four breeding programs which were initiated in 1957 with a foundation of Brahman-Native females:

1. Upgrading to British sire (Angus and Hereford)
2. Crisscrossing Angus and Hereford
3. Crisscrossing Angus and Brahman
4. Crisscrossing Hereford and Santa Gertrudis

Weaning data from the 1969 calf crop are presented in form S-10-1.

V. FUTURE PLANS:

Present procedures will be continued until breed composition becomes stable enough to evaluate the programs. The data from feeding steers produced in the four programs will be summarized for presentation.

VI. PUBLICATIONS:

Koger, et al. 1970. Production response and economic returns from Five Pasture Programs in North Central Florida. Fla. Agri. Exper. Sta. Bul. 740.

Koger, M. 1970. Replacing open cows and poor producers as a means for increasing economic returns. University of Fla. Beef Cattle Short Course.

VII. PUBLICATIONS PLANNED:

Two chapters in book on 1971 Short Course.

EVERGLADES EXPERIMENT STATION  
Belle Glade, Florida

I. PROJECT: 922

Angus, Brangus and Angus x Brangus crossbreds for beef production in the Everglades area.

II. OBJECTIVES:

1. To compare the performance of straightbred Angus and Brangus cattle with rotation crosses of the two breeds for beef production in the Everglades area.
2. To develop a highly productive herd of cattle at the Glades Correctional Institution through selection based on production testing.

III. PERSONNEL:

J. R. Crockett, D. W. Beardsley and M. Koger

IV. ACCOMPLISHMENTS DURING THE YEAR:

There were 1027 females of breeding age in the project. Blood composition has not stabilized to the point that performance of different breed groups can be evaluated with confidence.

V. FUTURE PLANS:

Increased selection pressure is to be initiated in order to speed up stabilization of breed composition of different groups.

VI. PUBLICATIONS:

None

VII. PUBLICATIONS PLANNED:

None

EVERGLADES EXPERIMENT STATION  
Belle Glade, Florida

I. PROJECT: 990

Breeding beef cattle for adaptation to South Florida conditions.

II. OBJECTIVES:

1. To compare the performance of progeny of Angus, Brahman and Hereford cattle, and from three possible two-breed rotational crosses of these breeds for beef production in the South Florida area.
2. To develop through selection, Angus and Hereford cattle which will be adapted to South Florida conditions.

III. PERSONNEL:

J. R. Crockett, D. W. Beardsley and M. Koger

IV. ACCOMPLISHMENTS DURING THE YEAR:

There were 419 females of breeding age in the project. Data from this project are shown in form S-10-1.

V. FUTURE PLANS:

Continue project as outlined. Study grazing habits and forage intake of the different breed groups.

VI. PUBLICATIONS:

None

VII. PUBLICATIONS PLANNED:

Three chapters in new crossbreeding book. Master thesis.

UNIVERSITY OF FLORIDA  
Agricultural Experiment Station  
Gainesville, Florida

I. PROJECT: 1003

Inherent body size in cattle as related to adaptation to Florida's climatic environment.

II. OBJECTIVES:

To determine the performance of three different groups of beef cattle selected respectively for:

1. Large skeletal and body size
2. Adaptation to Florida climate as reflected in thrift and vitality, and
3. The combination of weight and grade to give the greatest economic returns per animal unit.

III. PERSONNEL:

M. Koger, F. S. Baker and A. C. Warnick

IV. ACCOMPLISHMENTS DURING THE YEAR:

Two groups of 450 cows each are being used in a selection experiment. One group is being selected for large skeletal size to determine the effect this trait has on adaptability to Florida. Another group is being selected for indications of adaptability, measured mainly by condition score to determine whether animals selected for this trait tend toward any particular size. The project has not been under way long enough for the groups to become distinct.

V. FUTURE PLANS:

Continue project as outlined.

VI. PUBLICATIONS DURING THE YEAR:

None

VII. PUBLICATIONS PLANNED:

None

RANGE CATTLE EXPERIMENT STATION  
Ona, Florida

I. PROJECT: 1120

Charolais, Brahman, Angus and their crosses for beef production in South Florida.

II. OBJECTIVES:

To evaluate the relative productivity of Charolais, Brahman, Angus and their crosses for beef production in South Florida.

III. PERSONNEL:

F. M. Peacock, E. M. Hodges, H. L. Chapman and M. Koger

IV. ACCOMPLISHMENTS DURING THE YEAR:

Angus, Brahman and Charolais bulls are being mated to females of the same breeds in all possible combinations to produce straightbred and crossbred progeny. The three groups of  $F_1$  females likewise will be mated to the three breeds of bulls to produce backcross and three-breed cross progeny. A minimum of 90 straightbred females (10 per subgroup) are bred each year. A comparable number of crossbred females will be added to the project as they are produced. The post-weaning and feedlot performance of progeny produced in the trial are evaluated in a companion study. The seventh calf crop was weaned in 1970.

V. FUTURE PLANS:

Continue project as outlined.

VI. PUBLICATIONS DURING THE YEAR:

Peacock et al. 1969. Growth in Brahman, Shorthorn and crossbred cattle.  
J. Anim. Sci. 29:111.

VII. PUBLICATIONS PLANNED:

1. Chapter in new book on crossbreeding.
2. Two journal papers on performance of cattle of different breed compositions on high, medium and low nutritional levels.

EVERGLADES EXPERIMENT STATION  
Belle Glade, Florida  
(Project located at Brighton Seminole Indian Reservation)

I. PROJECT: 1263

Selection for maternal ability in beef cattle.

II. OBJECTIVES:

1. To compare maternal ability and individual excellence in weight and grade at 20 months of age as selection criteria in improvement of beef cattle.
2. To produce herd sires from adapted Hereford cattle for use in tribal herds.

III. ACCOMPLISHMENTS DURING THE YEAR:

There are 353 breeding age females in the project. The data are shown in form S-10-1.

IV. FUTURE PLANS:

Continue project as outlined.

V. PUBLICATIONS DURING THE YEAR:

None.

VI. PUBLICATIONS PLANNED:

None

A. G. DOZIER SCHOOL FOR BOYS  
Marianna, Florida

I. PROJECT: AL-01471

Beef and dairy x beef cross cattle for beef production in North Florida.

II. OBJECTIVES:

1. To obtain reproductive and performance information on beef and dairy x beef cross cows.
2. To estimate phenotypic and genetic parameters.

III. PERSONNEL:

D. E. Franke and J. F. Hentges, Jr.

IV. ACCOMPLISHMENTS DURING YEAR:

First calf crop from project weaned.

V. FUTURE PLANS:

Proceed as planned.

VI. PUBLICATIONS DURING YEAR:

None

VII. PUBLICATIONS PLANNED:

None

ANIMAL SCIENCE AND BROOKSVILLE BEEF CATTLE RESEARCH STATION  
Gainesville and Brooksville, Florida

I. PROJECT: AL-01501 and BR-01501

Breeding methods for beef cattle in Southern Region.

II. OBJECTIVES:

1. To select highly productive cows with Brahman characteristics from commercial herds and assess their breeding value for reproductive efficiency and calf survival as compared with those of purebred Brahman.
2. Determine superiority of selected grades following an additional backcross to Brahman bulls.
3. To compare combining ability of Brahman and grade bulls with British females

III. PERSONNEL:

M. Koger and D. E. Franke (Fla.); W. C. Burns and W. T. Butts (USDA)

IV. ACCOMPLISHMENTS DURING THE YEAR:

Herds established; first mating made.

V. FUTURE PLANS:

Continue as planned.

VI. PUBLICATIONS DURING THE YEAR:

None

VII. PUBLICATIONS PLANNED:

None

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Florida-Belle Glade

Location		Brighton	Brighton	GCI	GCI	GCI
Breed of sire		Hereford	Hereford	Angus	Angus & Brangus	Brangus
Breed of dam		Hereford	Hereford	Angus	Crossbreds	Brangus
Line or group <sup>1</sup>				Angus	A - Bg Rotation	Brangus
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	201	187	133	611	284
	Yearling Heifers	56	50	23	213	77
	Bulls and steers under 1 year	48	45	44	170	125
	Heifers under 1 year	33	22	46	172	73
	Bulls over 1 year	53	52	1		50
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	97	86	86	86	79
	Calf survival <sup>3</sup> percent	85	86	97	98	89
Wean. perf.	Adj. ADG <sup>4</sup>	1.77	1.65	1.57	1.61	1.39
	Av. type score <sup>5</sup>	12	11	10	10	8
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Florida

Location		RCS	RCS	RCS	RCS	RCS
Breed of sire		Angus	Brahman	Charolais	A,B & C	A,B & C
Breed of dam		Angus	Brahman	Charolais	A,B & C	F <sub>1</sub>
Line or group <sup>1</sup>		Pure A	Pure B	Pure C	F <sub>1</sub> Calves	Backcross & 3-backcrosses
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	12	12	12	72	108
	Yearling Heifers	4	4	2	20	17
	Bulls and steers under 1 year	2	5	3	20	33
	Heifers under 1 year	9	6	7	38	53
	Bulls over 1 year	3	3	3		
	Steers over 1 year	0	0	0	0	0
Repro. perf.	Percent pregnant <sup>2</sup>	77	100	86	67	87
	Calf survival <sup>3</sup> percent	100	100	100	95	94
Wean. perf.	Adj. ADG <sup>4</sup>	1.49	1.64	1.93	1.83	1.96
	Av. type score <sup>5</sup>	12	11	12	12	12
Postweaning performance	No. of bulls	0	0	0	0	0
	No. of heifers	0	0	0	0	0
	No. of steers	2	6	5	21	27
Slaughtered	No. of bulls	0	0	0	0	0
	No. of heifers	0	0	0	0	0
	No. of steers	2	6	5	21	27
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 6-2-71 State Project 1180  
1970-1971

State Florida

Location		Quincy	Quincy			
Breed of sire		Angus	Angus			
Breed of dam		Angus	Angus			
Line or group <sup>1</sup>		I	II			
Percent used in project		100	100			
Inventory as of July 1, 1971	Cows 2 years and over	39	40			
	1970 Yearling Heifers	20	9			
	1971 Bulls and steers under 1 year	17	17			
	Heifers under 1 year 1971	20	22			
	Bulls over 1 year 1970	21	20			
	Steers over 1 year	0	0			
Repro. perf.	Percent pregnant <sup>2</sup>	90	98			
	Calf survival <sup>3</sup> percent	92	92			
Wean. perf.	Adj. ADG <sup>4</sup>	1.96	1.94			
	Av. type score <sup>5</sup>	11.0*	11.0*			
Postweaning performance	No. of bulls	21	20			
	No. of heifers	15	14			
	No. of steers	0	0			
Slaughtered	No. of bulls	0	0			
	No. of heifers	0	0			
	No. of steers	0	0			
Remarks:						

Present inventory 6-2-71

1970 data

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Florida

Location		Beef Res. Unit	Beef Res. Unit	Beef Res. Unit	Beef Res. Unit
Breed of sire		A & H	A & H	A & B	H & SG
Breed of dam		A & H	HA & AH	BA & AB	SGH & HSG
Line or group <sup>1</sup>		Grades	A-H Crisscross	A-B Crisscross	H-SG Crisscross
Percent used in project		50	50	50	50
Inventory as of July 1, 1971	Cows 2 years and over	57	56	55	58
	Yearling Heifers	20	20	20	14
	Bulls and steers under 1 year	22	25	22	24
	Heifers under 1 year	23	25	21	24
	Bulls over 1 year	3	3	3	3
	Steers over 1 year	0	0	0	0
Repro. perf.	Percent pregnant <sup>2</sup>	82	92	86	94
	Calf survival <sup>3</sup> percent	78	83	70	86
Wean. perf.	Adj. ADG <sup>4</sup>	1.77	1.86	1.90	2.04
	Av. type score <sup>5</sup>	11	11	11	12
Postweaning performance	No. of bulls	0	0	0	0
	No. of heifers	0	0	0	0
	No. of steers	0	0	0	0
Slaughtered	No. of bulls	0	0	0	0
	No. of heifers	0	0	0	0
	No. of steers	0	0	0	0
Remarks:					

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Florida-Belle Glade

Location		Belle Glade	Belle Glade	Belle Glade		
Breed of sire		A	B	H		
Breed of dam		A	B	H		
Line or group <sup>1</sup>		Angus	Brahman	Hereford		
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over	37	35	38		
	Yearling Heifers	10	10	10		
	Bulls and steers under 1 year	15	15	15		
	Heifers under 1 year	15	15	15		
	Bulls over 1 year	8	6	9		
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	70	60	84		
	Calf survival <sup>3</sup> percent	84	88	71		
Wean. perf.	Adj. ADG <sup>4</sup>	1.33	1.64	1.54		
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Florida-Belle Glade

Location		Belle Glade	Belle Glade	Belle Glade		
Breed of sire		A-B	A-H	B-H		
Breed of dam		BA-AB	HA-HA	HB-B		
Line or group <sup>1</sup>		A-B Rotation	A-H Rotation	B-H Rotation		
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over	84	92	90		
	Yearling Heifers	36	33	33		
	Bulls and steers under 1 year	30	30	30		
	Heifers under 1 year	30	30	30		
	Bulls over 1 year	2	0	2		
	Steers over 1 year	25	25	25		
Repro. perf.	Percent pregnant <sup>2</sup>	69	85	84		
	Calf survival <sup>3</sup> percent	87	85	80		
Wean. perf.	Adj. ADG <sup>4</sup>	1.66	1.47	1.66		
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

BROOKSVILLE BEEF CATTLE RESEARCH STATION  
Brooksville, Florida

I. PROJECT: Work Unit No. 03-30-013-10-03  
-27-04

State Project 1186

A study of response to selection and genetic environmental interaction in genetically similar groups of Hereford cattle at two locations (Miles City, Montana and Brooksville, Florida).

II. OBJECTIVES:

1. To determine whether originally genetically similar groups of cattle bred and selected for several generations according to the same criteria in the two markedly different environmental conditions of Miles City, Montana and Brooksville, Florida become genetically different or remain similar.
2. To estimate the importance of genetic-environmental interaction within a British breed of beef cattle.
3. To determine the importance of adaptation to a specific location if maximum productivity is to be attained.

III. PERSONNEL:

Project committee composed of the following persons: Representatives of the Florida and Montana Agricultural Experiment Stations as designated by the respective directors; Superintendents of the Miles City and Brookville Stations, plus not more than one additional person from each station; the W-1 and S-10 Regional Coordinators; and the Chief of the Beef Cattle Research Branch, U. S. Department of Agriculture (Chairman).

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. The eighth calf crop has been weaned.
2. Performance of G.E.I. cattle in 1970 was as follows:

<u>Line</u>	<u>Calf Survival</u>	<u>Wean Rate</u>	<u>Wean Weight</u>	<u>Wean Age</u>	<u>Adj. Weight</u>	<u>Cond. Score</u>	<u>% Preg. Cows</u>	<u>% Preg. Heifers</u>
4	86	73	370	220	363	8	75	67
5	100	62	355	221	344	8	46	71
6	82	73	400	220	394	9	77	88

3. 1970 Production Performance of G.E.I. Cattle

Trait	4	5	6
Weaning rate, %	73	62	73
Weaning wt., lbs.	370	355	400
Preg. rate, avg. 1970, %	75	46	77
Cow efficiency, %	27	22	30
Cow weight, lbs.	1013	998	980
32-month heifer wt., lbs.	898	856	867
32-month preg. rate, %	67	71	88
20-month heifer wt., lbs.	627	556	656
550-day bull wt., lbs.	846	695	899

4. 1970 Milk Production, taken in April, June and August, for the G.E.I. cattle are as follows:

<u>Line</u>	<u>No. Cows</u>	<u>Avg. Milk Prod. (lbs.)</u>
4	52	5.43
5	12	5.22
6	32	5.72

5. 1970 Worming Treatment on G.E.I. Cattle

Group	Treatment	No.	Avg. 1969	Avg. 1970	Preg. %
Cow Herd					
Line 4	Untreated	27	1004	1008	59
Line 4	Treated	29	999	1018	90
Line 5	Untreated	8	978	1008	38
Line 5	Treated	5	932	984	60
Line 6	Untreated	16	973	960	75
Line 6	Treated	19	990	997	79
2-year-old Heifers					
Line 4	Untreated	12	676	891	75
Line 4	Treated	11	689	906	55
Line 5	Untreated	3	646	865	100
Line 5	Treated	4	637	850	50
Line 6	Untreated	7	694	867	86
Line 6	Treated	9	681	867	89

Hereford by Worm Program

	No.	Calf Surv. %	Wean Wt. lbs.	Wean Age Days	205 Wt. lbs.	Cond. Score	Preg. 1970 %
Untreated	51	86	366	218	361	8	61
Treated	53	86	388	221	380	8	83

6. 1970 Semen Traits in G.E.I. Bulls

Line	No.	Age (mo)	Vol. (ml)	Conc. $10^3/\text{mm}^3$	Total Cell Production $10^6$	Motility %
Line 4	16	21-34	6.35	418.13	2665.75	61.56
Line 5	3	22-34	7.10	356.66	2103.00	43.34
Line 6	16	20-34	5.82	491.87	2577.13	76.88
Average	35		6.42	422.23	2448.63	60.59

V. FUTURE PLANS:

Continue on the project outline.

VI. PUBLICATIONS DURING THE YEAR:

Butts, W. T., M. Koger, F. L. Pahnish, W. C. Burns and E. J. Warwick. 1971. Performance of two lines of Hereford cattle in two environments. J. Animal Sci. 5373.

VII. PUBLICATIONS PLANNED:

Blood thyroid levels in Hereford cattle at Brooksville, Florida, and Miles City, Montana.

Genetic and environmental factors associated with milk yield in beef cattle. PHD Dissertation.

I. PROJECT: State Project BR-01501

Breeding methods for beef cattle in the Southern region.

II. OBJECTIVES:

1. To select highly productive cows with Brahman characteristics from commercial herds and assess their breeding values for reproductive efficiency and calf survival, as compared with those of purebred Brahman.
2. To determine how much of any superiority of the selected grades is retained following an additional backcross to Brahman bulls.
3. To compare the combining ability of Brahman and grade bulls with British females as a measure of their utility for crossbreeding.

III. PERSONNEL:

Dr. Marvin Koger, University of Florida, Gainesville, Florida  
Dr. D. E. Franke, University of Florida, Gainesville, Florida  
Dr. Will T. Butts, USDA-ARS, Knoxville, Tennessee  
W. C. Burns, USDA-ARS, Brooksville, Florida

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. The first calf crop was weaned on this project. However, the calves from the grade Brahman cows were sold because they were sired by unknown bulls and were not a part of this project. The calving interval on the grade Brahman cows was 30 days longer than anticipated.
2. Performance of Brahman cattle in 1970 was as follows:

<u>Line</u>	<u>Calf Surv.</u>	<u>Wean Wt.</u>	<u>Wean Age</u>	<u>Adj. Wt.</u>	<u>Cond. Score</u>	<u>% Preg.<sup>x</sup> Cows</u>	<u>% Preg. Heifers</u>
Purebred	75	378	196	410	10	97	75
Grade	99	366	160	475	11	82	-

<sup>x</sup> The pregnancy rate is not a true comparison because there were a lot of open purebred Brahman due to the completion of the year-round breeding project. All of the grade Brahman were nursing a calf. The calving interval on the grade cows was also 30 days longer than the purebred cows.

3. A study on the phenotypic and physiological responses of normal and weak born Brahman calves was initiated. Each calf born was scored as normal or in various stages of weakness, pulse rate, temperature, rectal swab and 50 ml of blood was also taken in addition to birth weight, birth date, etc. We have nothing to report at this time except that the weak calves had about a 4 degree sub-normal temperature.

V. FUTURE PLANS:

Continue on the project outline.

VI. PUBLICATIONS:

None

VII. PUBLICATIONS PLANNED:

None

I. PROJECT: State Project BR-00755

Non-Protein nitrogen in wintering beef cattle.

II. OBJECTIVES:

To find economical ways of supplementing Winter rations on low quality roughage.

III. PERSONNEL:

Dr. Clarence Ammerman, University of Florida, Gainesville, Florida

Dr. M. Koger, University of Florida, Gainesville, Florida

Dr. D. E. Franke, University of Florida, Gainesville, Florida

W. C. Burns, USDA-ARS, Brooksville, Florida

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Following is the performance record on the 1969-1970 Wintering trial on Angus cattle.

<u>Group</u>	<u>No.</u>	<u>Calf Surv. %</u>	<u>Wean Wt. lbs.</u>	<u>Wean Age Days</u>	<u>205 Wt. Lbs.</u>	<u>Cond. Score</u>	<u>Preg. 1970 %</u>
Silage + C.S.P.	25	96	410	231	379	9	96
Silage + NPN P.	26	96	377	222	360	8	85
Hay + C.S.P.	26	96	377	225	358	9	93
Hay + NPN P.	25	100	395	225	374	9	81
Silage	51	96	394	227	370	8	90
Hay	51	98	386	225	366	9	87
C.S.P.	51	96	394	228	369	9	94
NPN P.	51	98	386	224	367	8	83

2. The Wintering program on Angus was revised to extend to the end of the breeding season and to include the following three treatments.

1. 2# of 41% C.S.P./head daily + roughage.
2. 2.2# of NPN cube shown below/head daily + roughage.
3. 1.90# of NPN cube minus biuret/head daily + roughage.  
 $86.25\% \times 2.2\# = 1.90\#.$

NPN (Biuret) Cube

Citrus Pulp	75.60%
Cane Molasses	7.00
Biuret (Kedlor)	13.75
Mono. Sod. P <sup>0</sup> 4	3.30
Sulfur	0.35
	<u>100.00%</u>

3.

April, 1971 - Milk Yield on Wintering Program

<u>Winter Program</u>	<u>Number</u>	<u>Milk Yield</u>
1.	37	6.57
2.	40	5.69 <sup>x</sup>
3.	36	6.01

<sup>x</sup> Significant at the 5% level.

V. FUTURE PLANS:

Continue the program for two more years to include first calf heifers and extend the feeding period to the end of the breeding season.

VI. PUBLICATIONS:

None

VII. PUBLICATIONS PLANNED:

The performance of Angus cattle on four Wintering programs.

I. PROJECT:

Miscellaneous project on Angus cows. Milk production and physiology of reproduction.

II. OBJECTIVES:

1. Milk production:

To measure and evaluate direct and indirect response to selection for milk yield and growth, respectively, in two herds of Angus cattle.

2. Physiology of reproduction:

To evaluate a single injection of FSH on first estrus after calving.

III. PERSONNEL:

Dr. Marvin Koger, University of Florida, Gainesville, Florida  
Dr. D. E. Franke, University of Florida, Gainesville, Florida  
Dr. A. C. Warnick, University of Florida, Gainesville, Florida  
W. C. Burns, USDA-ARS, Brooksville, Florida

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Milk Production

Group	Number	April	June	Aug.	Avg.
Angus	142	6.24	5.95	4.39	5.53
Purebred calves	128	6.35	5.94	4.37	5.55
Here. x Ang. Calves	14	5.27	6.08	4.60	5.32

A year's milk production on 142 Angus cows was obtained in April, June and August, 1970. The average milk production for the summer, was 5.53 pounds. This data was obtained by the nursing technique.

2. Physiology of Reproduction

The cows were palpated to determine ovarian activity. One-half of the cows were injected with FSH to determine if the treated group would come in heat and breed sooner than the control group.

V. FUTURE PLANS:

Continue to collect milk production data, while investigating problems in physiology of reproduction, and nutrition,

VI. PUBLICATIONS:

Cruz, Vladimar A., A. C. Warnick, D. E. Franke and W. C. Burns. Birth distributions as a measure of reproductive efficiency. Abstract.

Mills, A. C., A. C. Warnick, F. W. Bazer, W. C. Burns and F. M. Peacock. Response to single FSH injection in beef cattle. Fed. MGA. Abstract.

VII. PUBLICATIONS PLANNED:

Three months vs. year-round breeding.

Testes size and semen production in Hereford, Brahman, Angus and Santa Gertrudis bulls.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

 State Florida

Location		Brooksville	Brooksville	Brooksville	Brooksville	
Breed of sire		Hereford	Hereford	Hereford	Angus	
Breed of dam		Hereford	Hereford	Hereford	Angus	
Line or group <sup>1</sup>		Line 4	Line 5	Line 6	Purebred	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	87	23	50	174	
	Yearling Heifers	26	8	13	57	
	Bulls and steers under 1 year	26	3	14	65	
	Heifers under 1 year	20	3	13	50	
	Bulls over 1 year	31	6	23	79	
	Steers over 1 year	-	-	-	-	
Repro. perf.	Percent pregnant <sup>2</sup>	75	46	77	87	
	Calf survival <sup>3</sup> percent	86	100	82	96	
Wean. perf.	Adj. ADG <sup>4</sup>	1.77	1.68	1.92	1.82	
	Av. type score <sup>5</sup>	12	12	12	12	
Postweaning performance	No. of bulls	33	6	24	57	
	No. of heifers	20	8	16	59	
	No. of steers	-	-	-	-	
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Florida

Location		Brooksville	Brooksville	Brooksville	Brooksville	
Breed of sire		Brahman	Brahman	Hereford	Hereford	
Breed of dam		Brahman	Brahman	Hereford	Hereford	
Line or group <sup>1</sup>		Purebred	Grade	Line 4	Line 5	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	44	77	87	23	
	Yearling Heifers	16	-	26	8	
	Bulls and steers under 1 year	15	34	26	3	
	Heifers under 1 year	18	38	20	3	
	Bulls over 1 year	17	-	31	6	
	Steers over 1 year	-	-	-	-	
Repro. perf.	Percent pregnant <sup>2</sup>	97	82	75	46	
	Calf survival <sup>3</sup> percent	75	99	86	100	
Wean. perf.	Adj. ADG <sup>4</sup>	2.00	2.32	1.77	1.68	
	Av. type score <sup>5</sup>	11		12	12	
Postweaning performance	No. of bulls	22	-	33	6	
	No. of heifers	14		20	8	
	No. of steers	-		-	-	
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Florida

Location		Brooksville	Brooksville	Brooksville	Brooksville	
Breed of sire		Hereford	Angus	Brahman	Brahman	
Breed of dam		Hereford	Angus	Brahman	Brahman	
Line or group <sup>1</sup>		Line 6	Purebred	Purebred	Grade	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	50	174	44	77	
	Yearling Heifers	13	57	16	-	
	Bulls and steers under 1 year	14	65	15	34	
	Heifers under 1 year	13	50	18	38	
	Bulls over 1 year	23	79	17	-	
	Steers over 1 year	-	-	-	-	
Repro. perf.	Percent pregnant <sup>2</sup>	77	87	97	82	
	Calf survival <sup>3</sup> percent	82	96	75	99	
Wean. perf.	Adj. ADG <sup>4</sup>	1.92	1.82	2.00	2.32	
	Av. type score <sup>5</sup>	12	12	11		
Postweaning performance	No. of bulls	24	57	22	-	
	No. of heifers	16	59	14		
	No. of steers	-	-	-	-	
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

GEORGIA COASTAL PLAIN EXPERIMENT STATION  
Tifton, Georgia

## I. PROJECT: State 2-99 (S-10)

Selection of beef cattle for single items of importance in profitable beef production.

## II. OBJECTIVES:

To obtain preliminary information on the relative effectiveness of selecting for a single character.

To observe trends in characters for which no selection is made when selection is for a single character.

## III. PERSONNEL:

Hollis D. Chapman, T. M. Clyburn and W. C. McCormick

## IV. ACCOMPLISHMENTS DURING THE YEAR:

Four herds of grade Polled Hereford females, owned and maintained by the Georgia State Prison Farm, Reidsville, are used to study selecting for (1) weaning weight, (2) rate of postweaning gain, (3) type score, and (4) average performance. For the latter group, replacements with records nearest average for each trait are selected. Bulls used in all four groups are selected from the Polled Hereford herd at Tifton. Weaning data for the 1970 calf crop are shown in table 1.

Table 1. Weaning Data, Generation 2 Cows, 1970 Calf Crop

Herd	No. calves weaned	Avg. birth weight	ADG-birth to weaning	Weaning scores	
				Type	Condition
Average	39	74	1.64	10.8	8.7
Rate of gain	29	75	1.60	10.4	8.3
Score	45	71	1.60	11.0	8.9
Wean. weight	41	73	1.68	10.9	8.7

In each of three years (1967, 1968, 1969) approximately 48 generation 2 steers representing each sire-herd group were grazed and managed as a group until slaughtered. A summary of postweaning growth and carcass data is shown in table 2 by herds. In addition to herd, the model contained year as a main effect and age at slaughter and days on postweaning test as covariates.

Table 2. Least-Squares Means of Postweaning Traits of Steers by Herds  
(Generation 2)

Item <sup>a</sup>	Herd (selection criterion)			Average merit
	Postweaning ADG <sup>b</sup>	Weaning weight	Yearling type score	
Initial weight, kg *	190 <sup>b</sup>	208 <sup>a</sup>	194 <sup>b</sup>	201 <sup>ab</sup>
P. W. ADG, kg **	0.82 <sup>a</sup>	0.81 <sup>a</sup>	0.72 <sup>b</sup>	0.74 <sup>b</sup>
Final weight, kg **	428 <sup>ab</sup>	444 <sup>a</sup>	404 <sup>c</sup>	416 <sup>bc</sup>
Final WPDA, kg <sup>c</sup> **	0.77 <sup>ab</sup>	0.80 <sup>a</sup>	0.74 <sup>c</sup>	0.75 <sup>b</sup>
Carcass weight, kg **	244 <sup>ab</sup>	255 <sup>a</sup>	234 <sup>b</sup>	236 <sup>b</sup>
Carcass WPDA, kg **	0.44 <sup>a</sup>	0.46 <sup>a</sup>	0.42 <sup>b</sup>	0.43 <sup>b</sup>
Carcass grade	9.80	10.20	9.80	9.80
Rib fat (10-11th rib) cm	1.63	1.57	1.64	1.64
Rib eye area (10-11th rib), cm <sup>2</sup>	60.00	58.50	56.20	60.00
Rib eye area (10-11th rib) cm <sup>2</sup> /100 kg carcass	24.20	23.20	24.10	25.50

<sup>a</sup>\* or \*\* indicates that herd was a significant source of variation (\*=P<.05; \*\*= P<.01) in the analysis of variance of the item shown.

<sup>b</sup>ADG is average daily gain.

<sup>c</sup>WPDA is weight per day of age.

#### V. FUTURE PLANS:

The project will be continued as outlined.

#### VI. PUBLICATIONS DURING THE YEAR:

None

#### VII. PUBLICATIONS PLANNED:

A manuscript containing data from generation 1 cows (generation 2 animals) is being prepared.

## I. PROJECT: Animal Husbandry 209, AHRD d1-3 (S-10)

A study of grading, crisscrossing and rotational crossing as breeding systems for commercial beef production.

## II. OBJECTIVES:

To study the relative value of grading crisscrossing and rotational crossing as breeding systems for commercial beef production.

To study heterotic effects in crosses between Angus and Polled Hereford breeds, as compared to heterosis in crosses between these breeds and Santa Gertrudis-- a breed based partially on a Brahman foundation.

To study the comparative value of the Santa Gertrudis breed with the Angus and Polled Hereford breeds.

## III. PERSONNEL:

Hollis D. Chapman, T. M. Clyburn and W. C. McCormick

## IV. ACCOMPLISHMENTS DURING THE YEAR:

Weaning data for the 1970 calf crop raised by generation 2 animals are as shown in the following table.

Table 1. Weaning Data, 1970 Calves, Generation 2 Cows

Herd	Breeding system	No. calves born	Avg. birth wt.	ADG birth to weaning	Avg. type score	Avg. condition score
Gr. A	Grading-up	28	64	1.37	10.7	8.6
Gr. PH	Grading-up	32	71	1.59	10.9	8.9
Gr. SG	Grading-up	22	81	2.41	11.5	9.9
AxPH	Crisscrossing	35	68	1.59	11.2	9.3
AxSG	Crisscrossing	35	72	1.84	11.0	9.3
PHxSG	Crisscrossing	23	77	2.18	11.6	10.4
AxPHxSG	Rotational Crossing	40	73	1.89	11.4	9.9

## V. FUTURE PLANS:

The studies will be continued as planned.

## VI. PUBLICATIONS DURING THE YEAR:

Chapman, Hollis D., T. M. Clyburn and W. C. McCormick. Angus, Polled Hereford and Santa Gertrudis in a two-and three-breed rotational crossbreeding program. To be published in The Proceedings of the Twentieth Annual Beef Cattle Short Course, On Crossbreeding, University of Florida, Gainesville, May 5-8, 1971.

Chapman, Hollis D., T. M. Clyburn and W. C. McCormick. Brown Swiss crosses compared with beef crosses for beef production. To be published in The Proceedings of the Twentieth Annual Beef Cattle Short Course, On Crossbreeding, University of Florida, Gainesville, May 5-8, 1971.

Chapman, Hollis D., T. M. Clyburn and W. C. McCormick. Grading two- and three-breed rotational crossing as systems for production of calves to weaning. J. Anim. Sci. 31:642.

Chapman, Hollis D., T. M. Clyburn and W. C. McCormick. Grading two- and three-breed rotational crossing as systems for production of slaughter steers. J. Anim. Sci. 32: (In Press).

VII. PUBLICATIONS PLANNED:

Chapman, Hollis D., T. M. Clyburn and W. C. McCormick. Breeding Systems for Beef Production. To be published as a Research Bulletin after July 1, 1971, by the University of Georgia Agricultural Experiment Station.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Georgia

Location		Reidsville	Reidsville	Reidsville	Reidsville	
Breed of sire		PH	PH	PH	PH	
Breed of dam		PH	PH	PH	PH	
Line or group <sup>1</sup>		Rate of Gain	Wean Wt.	Type	Average	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	52	52	52	52	
	Yearling Heifers	20	28	25	25	
	Bulls and steers under 1 year	22	20	21	19	
	Heifers under 1 year	20	22	27	23	
	Bulls over 1 year	2	2	2	2	
	Steers over 1 year	12	12	12	12	
Repro. perf.	Percent pregnant <sup>2</sup>	80.8	80.8	92.3	80.8	
	Calf survival <sup>3</sup> percent	100.0	97.6	93.8	97.6	
Wean. perf.	Adj. ADG <sup>4</sup>	1.53	1.68	1.57	1.62	
	Av. type score <sup>5</sup>	10.3	10.9	11.0	10.8	
Postweaning performance	No. of bulls	0	0	0	0	
	No. of heifers	20	28	25	25	
	No. of steers	12	12	12	12	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	12	12	12	12	
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: none.

5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Georgia

Location		Reidsville	Reidsville	Reidsville	Reidsville	Reidsville
Breed of sire		A	PH	SG	A,PH	A,SG
Breed of dam		A	PH	SG	AxPH	AxSG
Line or group <sup>1</sup>		Grade	Grade	Grade	Crisscross	Crisscross
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	41	45	42	51	47
	Yearling Heifers	13	18	14	17	14
	Bulls and steers under 1 year	19	21	18	22	22
	Heifers under 1 year	16	14	13	21	17
	Bulls over 1 year	4	4	4	4	4
	Steers over 1 year	0	0	0	0	0
Repro. perf.	Percent pregnant <sup>2</sup>	85.4	77.8	73.8	84.3	83.0
	Calf survival <sup>3</sup> percent	94.3	100.0	96.8	95.4	97.4
Wean. perf.	Adj. ADG <sup>4</sup>	1.37	1.57	2.17	1.57	1.83
	Av. type score <sup>5</sup>	10.7	10.9	11.1	11.0	11.0
Postweaning performance	No. of bulls	0	0	0	0	0
	No. of heifers	13	18	14	17	14
	No. of steers	0	0	0	0	0
Slaughtered	No. of bulls	0	0	0	0	0
	No. of heifers	0	0	0	0	0
	No. of steers	0	0	0	0	0
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Georgia

Location		Reidsville	Reidsville	Tifton	Tifton	
Breed of sire		PH,SG	A,PH,SG	PH	A	
Breed of dam		PH,SG	A,PH,SG	PH	A	
Line or group <sup>1</sup>		Crisscross	3-breed X	Purebred	Purebred	
Percent used in project		100	100	80	80	
Inventory as of July 1, 1971	Cows 2 years and over	41	65	88	48	
	Yearling Heifers	14	30	22	9	
	Bulls and steers under 1 year	14	26	44	18	
	Heifers under 1 year	13	25	46	19	
	Bulls over 1 year	4	4	5	2	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant <sup>2</sup>	65.9	78.5	74	77.2	
	Calf survival <sup>3</sup> percent	85.2	94.1	91.0	88.6	
Wean. perf.	Adj. ADG <sup>4</sup>	2.13*	1.83*	1.85**	1.71**	
	Av. type score <sup>5</sup>	11.5	11.2	11.8	11.3	
Postweaning performance	No. of bulls	0	0	40	17	
	No. of heifers	14	30	46	18	
	No. of steers	0	0	0	0	
Slaughtered	No. of bulls	0	0	18	3	
	No. of heifers	0	0	23	9	
	No. of steers	0	0	0	0	
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.  
 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.  
 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.  
 4 - Indicate adjustments: \*none \*\*sex, age, age of dam  
 5 - Suggest S-10 scoring system; indicate if different.

UNIVERSITY OF KENTUCKY  
Agricultural Experiment Station  
Lexington, Kentucky

I. PROJECT: Animal Science 260 (S-10) (Revised)

Selection for increased growth rate in beef cattle.

II. OBJECTIVES:

To use growth rate as a single criteria for selection when measured at a year of age.

To investigate phenotypic and genetic relationships between various preweaning and postweaning performance traits, preweaning and postweaning conformation scores, and carcass traits.

To compare heritabilities of and the phenotypic and genetic correlations among various preweaning and postweaning performance traits, preweaning and postweaning conformation scores, and carcass traits when the estimates are obtained from two populations where the criteria of selection is different for each population.

III. PERSONNEL:

F. A. Thrift and J. D. Kemp

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Initiation of the revised project.

The project was revised in 1969 and 233 purebred Hereford cows, represented by 40 sires, were randomly allotted into two groups (Control, Select) on the basis of sire and age. The average age for each of the two lines was 4.6 years. A total of 17 different sires were used as foundation sires during the 3-year period, 1969-1971, and will be replaced by their selected sons according to the procedure outlined in table 1.

The first group of bulls available for selection (born in 1970) were weighed off their 160-day postweaning feeding test in March 1971. Of the 72 bulls available for selection, 6 were selected for the select line and 6 for the control line on a within-sire basis as illustrated in table 1. Each of the 12 selected bulls is backed up by a spare bull. The 365-day weights for the 12 selected bulls are presented in table 2. The 6 bulls selected for the select line averaged 136 pounds heavier at 365 days of age than all 72 bulls available for selection; whereas, the 6 bulls in the control line averaged 26 pounds heavier than all 72 bulls. These 12 bulls will be used for only one breeding season (2 years of age) and each of the 6 bulls in the select line will be replaced by his heaviest son at 365 days of age; whereas, each of the 6 bulls in the control line will be replaced by a randomly selected son as illustrated in table 1.

At the end of the 160-day postweaning test, 77 heifers (born in 1970) were available for selection. However, only the 10 poorest performing unthrifty heifers were culled, since most of the heifers will be needed for replacements.

In previous years, all heifers were managed to calve first at 2 years of age by ad libitum feeding of corn silage supplemented with ground shelled corn and protein during their first winter. However, considerable death loss of calves from these heifers has been encountered at calving time due to difficult births. In an attempt to alleviate some of the calf death losses, the heifers are currently being managed to calve first at 3 years of age. Consequently, they will remain on pasture and will receive very little supplemental feed during their first two winters.

## 2. Breeding, calving and culling of cows.

During a 70-day breeding season (May 1 to July 10) in 1970, 278 females (81 heifers and 197 cows) were exposed to 12 of the foundation sires, with females from the two lines being bred to each of the foundation sires. Of the 278 females exposed, 261 (76 heifers and 185 cows) were present in the herd when the calves were weaned in late September. Forty-eight of these 261 females (14 heifers and 34 cows) were culled at the time the calves were weaned. Of the 34 cows culled, 3 were culled for cancer eye. The remaining 31 cows and 14 heifers were not pregnant, as examined by rectal palpation. A high percentage of the non-pregnant cows were older cows. On January 13, 1970, there were 62 of the heifers and 152 of the cows available to calve. Nine of the 62 heifers and 8 of the 152 cows did not calve. One of the 152 cows died just prior to calving and 2 cows were disposed of because of prolapse. Of the 53 heifers and 141 cows that calved, 14 (26%) and 7 (5%) of the calves were lost at birth or shortly thereafter from the heifers and cows, respectively. These death losses are lower than for 1970, but are still considered to be very high.

## 3. Collection of carcass data.

After the 24 bulls were selected, the remaining 48 bulls were slaughtered and routine carcass data obtained. These data will be pooled with previously collected carcass data to determine the relationships between various preweaning, postweaning and carcass traits of young bulls.

## V. FUTURE PLANS:

Future plans are to continue according to the revised project outline.

## VI. PUBLICATIONS DURING THE YEAR:

Boling, J. A., F. A. Thrift and D. L. Cross. 1971. Plasma amino acid patterns in high and low-gaining yearling bulls and heifers. J. Anim. Sci. 32:371. (Abstr.).

Thrift, F. A. and C. W. Absher. 1971. Freeze vs. fire branding as methods of beef cattle identification. J. Range Management. 24:75.

Thrift, F. A. and C. W. Absher. 1971. Freeze vs. fire branding as methods of beef cattle identification. Kentucky Animal Science Research Report. Progress Report 188.

## VII. PUBLICATIONS PLANNED:

None.

TABLE 1. ILLUSTRATION OF BREEDING PROCEDURE BY SEASON FOR THE TWO LINES

Breeding season	Line											
	Select(s) <sup>a,b,c</sup>						Control(c) <sup>a,b,c</sup>					
1969	A	B	C	D	E	F	A	B	C	D	E	F
1970	A	B	C	D	E	F	A	B	C	D	E	F
1971	A	B	C	D	E	F	A	B	C	D	E	F
1972	A <sub>s1</sub>	B <sub>s1</sub>	C <sub>s1</sub>	D <sub>s1</sub>	E <sub>s1</sub>	F <sub>s1</sub>	A <sub>c1</sub>	B <sub>c1</sub>	C <sub>c1</sub>	D <sub>c1</sub>	E <sub>c1</sub>	F <sub>c1</sub>
1973	A <sub>s2</sub>	B <sub>s2</sub>	C <sub>s2</sub>	D <sub>s2</sub>	E <sub>s2</sub>	F <sub>s2</sub>	A <sub>c2</sub>	B <sub>c2</sub>	C <sub>c2</sub>	D <sub>c2</sub>	E <sub>c2</sub>	F <sub>c2</sub>
1974	A <sub>s3</sub>	B <sub>s3</sub>	C <sub>s3</sub>	D <sub>s3</sub>	E <sub>s3</sub>	F <sub>s3</sub>	A <sub>c3</sub>	B <sub>c3</sub>	C <sub>c3</sub>	D <sub>c3</sub>	E <sub>c3</sub>	F <sub>c3</sub>
1975	A <sub>s11</sub>	B <sub>s11</sub>	C <sub>s11</sub>	D <sub>s11</sub>	E <sub>s11</sub>	F <sub>s11</sub>	A <sub>c11</sub>	B <sub>c11</sub>	C <sub>c11</sub>	D <sub>c11</sub>	E <sub>c11</sub>	F <sub>c11</sub>
	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
	etc.						etc.					

<sup>a</sup>A,B,C,D,E,F represent foundation sires used across both lines during the first 3 years of the experiment.  
<sup>b</sup>A<sub>s1</sub> represents heaviest bull at 365 days sired by foundation sire A, and A<sub>c1</sub> represents randomly selected bull sired by A, etc.  
<sup>c</sup>A<sub>s11</sub> represents heaviest bull at 365 days sired by A<sub>s1</sub>, and A<sub>c11</sub> represents randomly selected bull sired by A<sub>c1</sub>, etc.

TABLE 2. 365-DAY WEIGHTS FOR FIRST GROUP OF SELECTED BULLS  
(BORN IN 1970) BY LINE AND FOUNDATION SIRE

Foundation sire	Line <sup>a</sup>		s-c
	Select(s)	Control(c)	
A	A <sub>s1</sub> = 809	A <sub>c1</sub> = 692	117
B	B <sub>s1</sub> = 810	B <sub>c1</sub> = 764	46
C	C <sub>s1</sub> = 930	C <sub>c1</sub> = 758	172
D	D <sub>s1</sub> = 847	D <sub>c1</sub> = 747	100
E	E <sub>s1</sub> = 853	E <sub>c1</sub> = 774	79
F	F <sub>s1</sub> = 851	F <sub>c1</sub> = 740	111
Avg. <sup>b</sup>	850	746	104

<sup>a</sup>A<sub>s1</sub> represents heaviest bull at 365 days sired by foundation sire A, and A<sub>c1</sub> represents randomly selected bull sired by A, etc.

<sup>b</sup>Average 365-day weight for all 72 bulls available for selection was 720 pounds.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Kentucky

Location		Princeton	Princeton	Princeton		
Breed of sire		Hereford	Hereford	Hereford		
Breed of dam		Hereford	Hereford	Hereford		
Line or group <sup>1</sup>		Control	Select	Foundation sires		
Percent used in project		100	100			
Inventory as of July 1	Cows 2 years and over	105	103			
	Yearling Heifers	35	30			
	Bulls and steers under 1 year	38	41			
	Heifers under 1 year	46	38			
	Bulls over 1 year	12	12	19		
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	96	94			
	Calf survival <sup>3</sup> percent	87	76			
Wean. perf.	Adj. ADG <sup>4</sup>	1.70	1.68			
	Av. type score <sup>5</sup>	11	11			
Postweaning performance	No. of bulls	41	31			
	No. of heifers	41	36			
	No. of steers					
Slaughtered	No. of bulls	24	24			
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

LOUISIANA STATE UNIVERSITY  
Agricultural Experiment Station  
Baton Rouge, Louisiana

I. PROJECT: Hatch 605 (Revised)

General Title: Breeding methods for beef cattle in the Southern region.

Specific Title: Evaluation of systematic rotational crossbreeding plans for producing beef cattle in the Gulf Coast region.

II. OBJECTIVES:

1. To evaluate systematic breeding procedures.
2. To estimate genetic parameters and genetic-environmental interactions of biological and economic traits.

III. PERSONNEL:

J. W. Turner, George L. Robertson, T. D. Bidner, P. E. Humes, S. E. McCraine, Ted O. McRae and Dorothy C. Wilson

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work:

The 1970 calf crop was the first produced under the revised project outline. Straightbred Angus, Brahman, Charolais and Hereford calves and Angus, Charolais and Hereford backcrosses from Brahman crossbred cows and three-breed cross calves from Angus x Brahman and Hereford x Brahman cows were produced. The 11 breeding lines represent four straightbred, three criss-cross, three three-breed rotationals and one four-breed rotational mating scheme. Data collection and record format changes have been made. A combined inventory and data record of preweaning performance system has been devised to aid in checking and simplifying permanent record keeping.

Management changes have been made according to "dry run" results obtained from the 1969 calf crop during the transition period. Namely, castration was delayed until about 4 months of age rather than at birth. Also, composition changes were made in the pasture and feedlot rations.

No major difficulties have been encountered in the execution of the project. However, one double-muscled, flexed pastern calf was produced in line 3. (Charolais) revealing that the inheritance for these conditions is present in the breeding herds.

2. Research results:

Table 1 contains summary statistics of preweaning performance for the 1970 calf crop. Also, additional data of reproductive performance and cow size are given.

The 1970 calf crop included 266 calves born; 249 were weaned. Ten calves were stillborn and 3% of the births required assistance.

Table 2 contains least-squares means for preweaning traits with their standard errors. These means are adjusted for the effects of sex, age of calf and age of dam.

Table 3 contains derived statistics of adjusted weaning weight per cow exposed to breeding and the line production of adjusted weaning weight per cow as a ratio of weaning cow weight.

Results obtained from a study of age of castration on subsequent preweaning and postweaning performance were reported at the Southern Section Meetings in Jacksonville, Florida.

#### V. FUTURE PLANS:

Data collection and operation will continue as outlined.

Additional reproductive studies are planned on heifers retained for Phase II of the project. Particular attention will be directed toward estrus synchronization.

#### VI. PUBLICATIONS DURING THE YEAR:

Davis, W. L. and J. W. Turner. 1971. Effects of age at castration in beef steers. J. Anim. Sci. 32:377. (Abstr.).

#### VII. PUBLICATIONS PLANNED:

McDonald, R. P. and J. W. Turner. 1971. Parental breed and weight effects on preweaning performance.

TABLE 1. PREWEANING SUMMARY STATISTICS OF 1970 CALF CROP

Line of breeding <sup>a</sup>	No. cows	Percent calving	Percent weaned	Birth date	Birth weight	Weaning age	Weaning weight <sup>b</sup>	Weaning cow weight	Weaning ratio <sup>c</sup>
A (1)	35	77	71	40	63	236	421	1,024	0.40
B (2)	30	63	47	68	62	210	427	1,069	0.44
C (3)	31	68	64	54	86	226	530	1,180	0.45
H (4)	28	61	54	50	71	230	418	1,050	0.39
A <sup>3</sup> B <sup>1</sup> (5)	28	86	86	43	61	235	492	1,066	0.46
C <sup>3</sup> B <sup>1</sup> (6)	28	89	82	52	69	224	534	1,161	0.47
H <sup>3</sup> B <sup>1</sup> (7)	31	90	90	45	68	233	510	1,089	0.47
C <sup>2</sup> A <sup>1</sup> B <sup>1</sup> (8)	27	85	70	42	70	237	541	1,039	0.51
A <sup>2</sup> H <sup>1</sup> B <sup>1</sup> (9)	31	97	97	47	64	231	523	1,089	0.48
C <sup>2</sup> H <sup>1</sup> B <sup>1</sup> (10)	31	87	87	47	77	231	559	1,099	0.51
H <sup>2</sup> A <sup>1</sup> B <sup>1</sup> (11)	27	93	89	44	71	235	538	1,033	0.50
Average	327	81	76	48	69	231	505	1,083	0.46

<sup>a</sup>Breeds are coded: A = Angus, B = Brahman, C = Charolais, H = Hereford. Crossbred breedings refer to proportion of blood in crisscross and three- and four-breed rotation lines, i.e., A<sup>3</sup>B<sup>1</sup> means 3/4 Angus and 1/4 Brahman.

<sup>b</sup>Unadjusted.

<sup>c</sup>Ratio of adjusted weaning weight to weaning cow weight.

TABLE 2. 1970 PREWEANING PERFORMANCE OF STRAIGHTBRED, BACKCROSS AND THREE-BREED CROSSES BY LINE OF BREEDING<sup>a</sup>

Breeding of line <sup>b</sup>	Number	Birth wt. (lb.)	Slaughter score	Type Score	Weaning wt. (lb.)	Percent calf crop weaned
Straightbred						
A(1)	25	64 ± 2.0	10.3 ± 0.2	11.6 ± 0.2	415 ± 10	71.4
B(2)	14	61 ± 2.8	10.8 ± 0.3	11.8 ± 0.3	465 ± 14	46.7
C(3)	20	85 ± 2.3	10.4 ± 0.2	13.3 ± 0.2	533 ± 11	64.5
H(4)	15	71 ± 2.6	10.2 ± 0.2	11.6 ± 0.3	414 ± 13	53.6
Backcross						
A <sup>3</sup> B <sup>1</sup> (5)	24	62 ± 2.1	11.5 ± 0.2	11.8 ± 0.2	489 ± 10	85.7
C <sup>3</sup> B <sup>1</sup> (6)	23	70 ± 2.1	10.8 ± 0.2	12.9 ± 0.2	544 ± 10	82.1
H <sup>3</sup> B <sup>1</sup> (7)	28	68 ± 1.9	11.8 ± 0.2	12.1 ± 0.2	509 ± 9	90.3
Three-Breed						
C <sup>2</sup> A <sup>1</sup> B <sup>1</sup> (8)	19	73 ± 2.3	10.8 ± 0.2	12.9 ± 0.2	529 ± 11	70.1
A <sup>2</sup> H <sup>1</sup> B <sup>1</sup> (9)	30	65 ± 1.8	12.0 ± 0.2	12.3 ± 0.2	522 ± 9	96.8
C <sup>2</sup> H <sup>1</sup> B <sup>1</sup> (10)	27	78 ± 1.9	11.4 ± 0.2	13.3 ± 0.2	562 ± 9	87.1
H <sup>2</sup> A <sup>1</sup> B <sup>1</sup> (11)	24	72 ± 2.1	11.8 ± 0.2	12.5 ± 0.2	520 ± 10	88.9
Average	249	69.9	11.1	12.4	500.2	76.1

<sup>a</sup>Least squares means ± standard error.

<sup>b</sup>Breeds are coded: A = Angus, B = Brahman, C = Charolais and H = Hereford. Crossbred breeding refers to proportion of blood, i.e., A<sup>3</sup>B<sup>1</sup> means 3/4 Angus and 1/4 Brahman.

TABLE 3. PREWEANING PRODUCTIVITY BY LINE OF BREEDING

Line of Breeding <sup>a</sup>	Adj. weaning weight per cow exposed	Weaning weight ratio <sup>b</sup>
A (1)	296	0.29
B (2)	217	0.20
C (3)	344	0.29
H (4)	222	0.21
A <sup>3</sup> B <sup>1</sup> (5)	419	0.39
C <sup>3</sup> B <sup>1</sup> (6)	447	0.38
H <sup>3</sup> B <sup>1</sup> (7)	460	0.42
C <sup>2</sup> A <sup>1</sup> B <sup>1</sup> (8)	372	0.36
A <sup>2</sup> H <sup>1</sup> B <sup>1</sup> (9)	505	0.46
C <sup>2</sup> H <sup>1</sup> B <sup>1</sup> (10)	489	0.44
H <sup>2</sup> A <sup>1</sup> B <sup>1</sup> (11)	462	0.45
Total	380	0.35

<sup>a</sup> See footnotes Tables 1 and 2.<sup>b</sup> Ratio of adjusted weaning weight, per cow exposed to breeding to weaning cow weight.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Louisiana

Location		Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge
Breed of sire		Angus	Angus	Charolais	Hereford	Brahman
Breed of dam		Angus	A x B	A x B	A x B	Brahman
Line or group <sup>1</sup>		1	5	8	11	2
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	35	11	12	9	32
	Yearling Heifers	14	7	4	3	9
	Bulls and steers under 1 year	21	6	6	5	11
	Heifers under 1 year	9	5	4	2	14
	Bulls over 1 year	8	0	0	0	2
	Steers over 1 year	0	0	0	0	0
Repro. perf.	Percent pregnant <sup>2</sup>	77	92	92	91	63
	Calf survival <sup>3</sup> percent	71	92	67	82	47
Wean. perf.	Adj. ADG <sup>4</sup>	1.52	1.77	1.78	2.02	1.72
	Av. type score <sup>5</sup>	12	12	13	13	12
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers	11	4	4	6	5
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	11	4	4	6	5
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.  
 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.  
 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.  
 4 - Indicate adjustments:  
 5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Louisiana

Location		Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge
Breed of sire		Angus	Charolais	Hereford	Angus	Charolais
Breed of dam		B x A	B x A	B x A	B x H	B x H
Line or group <sup>1</sup>		5	8	11	9	10
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	12	13	16	15	12
	Yearling Heifers	7	5	4	7	7
	Bulls and steers under 1 year	5	10	7	8	4
	Heifers under 1 year	7	2	6	7	6
	Bulls over 1 year	0	0	0	0	0
	Steers over 1 year	0	0	0	0	0
Repro. perf.	Percent pregnant <sup>2</sup>	81	80	94	94	88
	Calf survival <sup>3</sup> percent	81	73	94	94	88
Wean. perf.	Adj. ADG <sup>4</sup>	1.90	2.00	1.96	1.95	2.12
	Av. type score <sup>5</sup>	12	13	12	12	14
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers	6	5	11	8	7
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	6	5	11	8	7
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Louisiana

Location		Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge
Breed of sire		Hereford	Charolais	Charolais	Hereford	Angus
Breed of dam		B x H	Charolais	C x B	Hereford	H x B
Line or group <sup>1</sup>		7	3	6	4	9
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	13	34	29	26	15
	Yearling Heifers	8	8	11	5	8
	Bulls and steers under 1 year	6	9	11	8	7
	Heifers under 1 year	8	17	13	13	7
	Bulls over 1 year	0	6	0	6	0
	Steers over 1 year	0	0	0	0	0
Repro. perf.	Percent pregnant <sup>2</sup>	100	68	89	59	100
	Calf survival <sup>3</sup> percent	100	64	82	52	100
Wean. perf.	Adj. ADG <sup>4</sup>	1.95	1.96	2.07	1.51	1.97
	Av. type score <sup>5</sup>	12	13	13	12	13
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers	7	12	12	9	7
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	7	12	12	9	7
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: NO ADJUSTMENTS.

5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Louisiana

Location		Baton Rouge	Baton Rouge		Baton Rouge	
Breed of sire		Charolais	Hereford			
Breed of dam		H x B	H x B			
Line or group <sup>1</sup>		10	7		TOTALS	
Percent used in project		100	100		100	
Inventory as of July 1, 1971	Cows 2 years and over	12	13		309	
	Yearling Heifers	7	7		121	
	Bulls and steers under 1 year	6	7		137	
	Heifers under 1 year	5	6		131	
	Bulls over 1 year	0	0		22	
	Steers over 1 year	0	0		0	
Repro. perf.	Percent pregnant <sup>2</sup>	87	80		81	
	Calf survival <sup>3</sup> percent	87	80		76	
Wean. perf.	Adj. ADG <sup>4</sup>	2.06	1.84		1.88	
	Av. type score <sup>5</sup>	13	12		12	
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers	5	5		124	
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	5	5		124	
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

IBERIA LIVESTOCK EXPERIMENT STATION  
Jeanerette, Louisiana

I. PROJECT: 03-30-002-19-06 (Revision No. 2)

Selection for changes in fat in beef cattle and the response of selection for adaptability of beef cattle in the Gulf Coast area.

II. OBJECTIVES:

1. To determine if changes in fat thickness of Angus and Brangus cattle can be made by selection in opposite directions for fatness--high fat and low fat.
2. To estimate genetic and environmental relationships of fatness and leanness with other performance and carcass traits.
3. To determine whether changes in adaptation and performance of Angus cattle can be made by selection of the best available sires from within the herd or by selection of the best available bulls from outside the area.

III. PERSONNEL:

T. M. DeRouen, D. C. Meyerhoeffer<sup>2</sup>, W. L. Reynolds, B. F. Hollon<sup>1</sup>, H. C. Gonsoulin and N. T. Poche, Jeanerette, Louisiana.  
A. M. Mullins<sup>4</sup> and J. W. Turner, Baton Rouge, Louisiana.  
W. T. Butts, Jr., Knoxville, Tennessee.  
P. A. Putnam, Beltsville, Maryland.

<sup>1</sup>Acting Superintendent from January - August 1970.

<sup>2</sup>Returned from sabbatic leave August 1970.

<sup>3</sup>Resigned September 1970.

<sup>4</sup>Resigned July 1970.

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope of work.

Data were collected on several aspects of the studies during the year. A total of 336 cows were bred in 1970. There were 22 single sire breeding herds. Calves were born in February, March, and April. Calves were weaned when each one reached  $180 \pm 7$  days. Bull calves were left entire. All calves were measured for fat thickness at weaning. Bull calves went directly into dry lot for gain-evaluation test and fat measurement at the end of the test. Sixty-five percent of the bulls were slaughtered for carcass evaluation and other measurements. Heifer calves were returned to pasture and supplemented with a small amount of concentrate feed and molasses on pasture. They were managed to gain one pound per head daily until two years of age.

2. Research results.

Breeding season and conception. The breeding season began on April 15 and ended on July 1 (75 day period). Two herds of Angus cows in the adaptability

study were bred artificially. All cows exposed to bulls during the breeding season were palpated for pregnancy in late October. A summary of the pregnancy rate is presented in Table 1. The pregnancy rate in 1970 was better than usual for all lines.

The high fat Brangus cows were more fertile in 1970 than the low fat Brangus cows, but this may be a year effect. Fertility between the fat lines in the Angus breed is similar. The pregnancy rate of the Angus cows in the adaptability study was good, especially for the artificially mated line.

The breeding season in 1970 was moved from May 1 to April 15 since there were no straightbred Brahman cattle in the study.

Yearling replacement heifers weighing six (600) hundred pounds and over were put in the breeding herds in 1970. Fifteen (15) Brangus heifers had a 47 percent conception rate while eight (8) Angus fat heifers had a pregnancy rate of 88 percent. Only one of two Angus heifers in the adaptability study got pregnant. Table 1 summarizes the fertility rate.

Calving. Calving in 1970 was near normal. Brangus calves had the greatest mortality. A summary of calving is presented in Table 2.

Cow Production - 1970 Calf Crop. Cow performance is summarized in Table 3. Live fat measurements and visual condition scores denote the small differences between the high and low fat lines in both breeds. The lines are showing trends toward separation. Low fat calves in both breeds showed a three percent greater survival to weaning than similar calves in the high fat line. All other traits measured were similar.

Postweaning Performance of Bulls - 1970. After weaning, bull calves in the fat study were placed on full feed in dry lot in groups. Each bull calf was fed to a weight of 800 pounds. Fat thickness, at this weight, was estimated over the 12th and 13th ribs with an ultrasonic instrument. Samples of bulls from each sire were slaughtered for carcass fat measurements, carcass merit and quality.

Brangus (Fat): The average daily gain was considerably higher for the low fat bulls. Several bulls in the high fat line failed to reach 800 pounds at 400 days of age which is the cut-off time for all calves on feed test. This is the first time that daily growth for the Brangus bulls has been so disappointing. Table 4 summarizes the postweaning performance of these bulls.

Angus (Fat): The low fat bulls gained slightly faster than contemporaries in the high fat group. Type score was slightly higher for the high fat bulls. Table 4 summarizes the data of these bulls.

Angus (Adaptability): Each bull calf after weaning is fed to a constant age of 365 days. Growth rate and conformation are evaluated and an index is computed for each bull giving equal emphasis to these two traits.

All traits between the closed line and the outside line are similar except the initial weight which is the actual weight at weaning. Table 4 presents the summary of the postweaning performance.

Slaughter data of bulls - 1970: Bulls gained much slower in 1969-70 than in previous years. No serious outbreaks of diseases or injuries hampered the

bulls. Weather conditions were generally good. Bulls graded well in 1970. All carcasses graded as steers. The packer was pleased with carcasses.

Brangus (Fat): The yield grade, marbling score, percent of kidney fat, and fat thickness of the ribeye tracings indicated that the low fat bulls had more fat than similar bulls in the high fat line in 1970. Shear scores between lines were similar. Low fat bulls had a higher dressing percent which was due to the higher fat of the low fat line in 1970. There was a tendency for the high fat bulls to have a slightly higher conformation score. Table 5 summarizes the slaughter data.

Angus (Fat): Low fat bulls had a more rapid growth rate, more tender lean, less marbling, and a greater percent of kidney fat while the high fat bulls had a higher carcass conformation score, lower yield grade, and a larger rib eye area. Refer to Table 5 for summary.

Angus (Adaptability): The closed line bulls had heavier carcasses with a higher dressing percent, higher carcass quality grade, more marbling and more tender lean. Bulls in the outside line grew slightly faster. They had a lower yield grade, less kidney fat, and less fat thickness on the carcass. See Table 5 for summary.

#### Performance of Replacement Heifers.

Heifers born in 1969: The fat lines in both breeds are showing tendency toward separation into their respective low and high fat lines. The study is six (6) years old. The low fat heifers in both breeds are growing slightly faster than contemporaries in the high fat line. The high fat heifers in both breeds showed slightly higher conformation scores. Table 6 summarizes the data on these heifers.

Heifers born in 1970: The adaptability closed line Angus heifers grew faster than the outside line heifers. Numbers are small for the outside line heifers.

Angus heifers in the high fat line had a slightly greater weight per day of age than the low fat heifers.

The low fat Brangus heifers had a slightly more rapid growth rate than the high fat heifers. Table 7 presents the summary of the performance of the replacement heifers born in 1970.

Weight of Cows. The mean weight of cows in the low fat line of both breeds showed a slightly heavier weight than the high fat cows.

Weights of the adaptability cows were similar for both lines.

See Table 8 for summary of cow weights for 1970.

#### V. IMPROVEMENT OF FACILITIES:

1. Completed construction of fencing of lane at annex to facilitate handling and moving cattle.
2. Repaired feeding barn that was eaten up by termites.

3. Drainage ditches cleaned and eight bridges were repaired or replaced in pastures.
4. Numerous gates were repaired or replaced in pastures.
5. Feed troughs in feeding barn were repaired or replaced where bulls are group fed.

#### VI. FUTURE PLANS:

1. To follow plan of projects.
2. Improvement of facilities:
  - a. Repair working pens at annex.
  - b. Build roof over chute at annex to enable its use during rain and inclement weather.
  - c. Build two holding pens with loading chutes at different places at annex to keep from having to drive cattle across a busy highway and two railroads--and also to keep from having to drive sick or injured cattle long distances (1 1/4 miles).

#### VII. PUBLICATIONS:

DeRouen, T. M., N. T. Poche, W. L. Reynolds, H. C. Gonsoulin, and D. C. Meyerhoeffer. 1970. Mortality of Newborn Beef Calves in the Gulf Coast Area. Louisiana Agriculture, Vol. 14, No. 2.

DeRouen, T. M., W. L. Reynolds, A. M. Mullins, H. C. Gonsoulin, N. T. Poche and B. F. Hollon. January 1970. Selection for Adaptability in Beef Cattle to the Gulf Coast Area. Tenth Livestock Producers' Day Report. Animal Science Department, Louisiana State University, Baton Rouge.

DeRouen, T. M., W. L. Reynolds, A. M. Mullins, H. C. Gonsoulin, N. T. Poche and B. F. Hollon. January 1970. Selection for Changes in Fatness in Beef Cattle. Tenth Livestock Producers' Day Report. Animal Science Department, Louisiana State University, Baton Rouge.

Reynolds, W. L., R. A. Bellows, T. M. DeRouen and D. C. Meyerhoeffer. 1970. Cow Response to FSH Treatment. J. Anim. Sci. 31:229 (Abstr.).

Reynolds, W. L., H. C. Gonsoulin, T. M. DeRouen, N. T. Poche, and D. C. Meyerhoeffer. 1970. Feeding Molasses-Urea Mix to Beef Cattle. Louisiana Agriculture, Vol. 14, No. 1.

Reynolds, W. L., H. C. Gonsoulin, T. M. DeRouen, T. W. White, N. T. Poche and D. C. Meyerhoeffer. 1970. Feeding Molasses and Urea Mixtures to Beef Cattle. Louisiana Cattleman. Vol. LXX, No. 11.

#### VIII. PUBLICATIONS PLANNED:

Review of the old project concerning straight-bred and strains of crossbred cattle--Brangus, Africander-Angus, Angus and Brahman.

Table 1. Palpation Summary for 1970

Breed	Line	No. Cows Exposed	Percent Pregnant
Brangus	Hi Fat	62	84
Brangus	Lo Fat	63	73
Angus	Hi Fat	59	80
Angus	Lo Fat	67	82
Angus	Adapt. Closed	52	85
Angus	Adapt. Outside (a)	33	82
Totals & Average		336	81

(a) Bred artificially.

Table 2. Calving Report - March 1970

Breed	Losses 1st 72 hours				Losses after 72 hours				Totals		
	Males	Heifers	Dead		Males	Heifers	Dead		No. Born	No. Dead	% Dead
			No.	%			No.	%			
Brangus	3	3	6	8	0	2	2	2	77	8	10
Angus Fat	2	0	2	2	2	0	2	2	96	4	4
Angus Adapt.	0	0	0	0	0	0	0	0	55	0	0
Totals	5	3	8	4	2	2	4	2	228	12	5

Table 3. Cow Production - 1970

Breed Study Line	Brangus		Brangus		Angus		Angus		Angus	
	Fat	Hi	Fat	Lo	Fat	Hi	Fat	Lo	Adapt. Local	Adapt. Outside(e)
No. cows exposed	63		59		55		64		52	30
No. calves born (a)	46		31		47		49		40	15
Avg. birth wt. (lbs.)	63		68		61		57		58	58
No. calves weaned	40		28		43		46		40	15
% calves weaned	87		90		91		94		100	100
Avg. wean. age (days)	180		179		180		180		180	179
Actual wean. wt. (lbs.)	370		368		313		309		294	290
Adjusted wean. ADG (lbs.)(b)	1.82		1.80		1.55		1.53		1.42	1.40
Grades: conformation (c)	10.70		10.20		11.30		10.70		11.40	10.80
condition (c)	9.30		8.90		9.20		8.40		8.30	8.00
Fat thickness, mm.	3.70		3.00		3.40		3.30		----	----
Index (d)	115		112		108		105		105	101

- (a) Includes live and dead calves.
- (b) Adjusted for sex of calf and age of dam.
- (c) Good = 9, 10, 11. Standard = 6, 7, 8.
- (d) Equal emphasis to growth and to conformation.
- (e) Artificially inseminated.

Table 4. Postweaning Performance of Bulls Fed in 1969-70.

Breed Study Line	Brangus			Angus			Angus		
	Fat	Hi	Lo	Fat	Hi	Lo	Fat	Adapt. Closed	Angus Adapt. Outside
Number fed	16		10		10	15		15	11
Avg. initial wt. (lbs.)	386		412		286	299		281	263
Number days fed	215		159		211	205		186	184
Avg. final wt. (lbs.)	766(a)		797(a)		769(a)	774(a)		701(d)	682(d)
ADG on test (lbs.)	2.15		2.51		2.23	2.32		2.25	2.27
Avg. age end test (days)	408		341		388	384		365	365
Avg. type score (b)	10.7		10.3		11.7	11.0		12.3	12.1
Avg. condition score (b)	10.0		9.4		11.2	10.8		11.1	11.3
Fat thickness (mm.)(c)	7.0		6.3		7.8	6.1		-----	-----
Fat thickness (in.)(c)	0.28		0.25		0.31	0.24		-----	-----
% Zebu	42.72		41.21		-----	-----		-----	-----
% inbreeding	2.83		2.18		None	None		0.73	None
Index	-----		-----		-----	-----		105	104

- (a) Each bull fed to a constant weight of 800 pounds or to 400 days of age.  
 (b) Choice = 12, 13, 14. Good = 9, 10, 11.  
 (c) Measured when each bull weighed 800 pounds or at 400 days of age.  
 (d) Each bull weighed at 365 days of age.

Table 5. Slaughter Data of Bulls - Fed in 1969-70

Breed Study Line	Brangus			Angus			Angus Adapt. Closed			Angus Adapt. Outside		
	Hi	Fat	Lo	Hi	Fat	Lo						
Number slaughtered	11		5	6		10	10			8		
Final weight (lbs.)(c)	759		902	766		828	749			740		
Slaughter age (days)	416		428	434		417	434			433		
Days fed	236		244	255		236	254			250		
ADG (lbs.)	1.78		1.95	1.88		2.13	1.90			1.95		
Slaughter weight (lbs.)(d)	746		887	753		814	736			728		
Slaughter scores:												
Type	10.7		9.9	12.0		10.5	12.2			12.6		
Condition	9.0		8.5	11.1		10.2	11.2			11.0		
Carcass weight-warm (lbs)	440		531	456		494	444			427		
Dressing percent-warm	58.9		59.8	60.6		60.7	60.4			58.6		
Carcass grades: (a)												
Conformation	12.0		11.8	13.0		12.0	12.5			13.0		
Composite	10.2		10.6	10.7		10.5	10.2			10.2		
Quality	9.8		10.0	9.8		9.5	10.2			9.2		
Yield	1.8		1.9	2.0		2.4	2.0			1.8		
Marbling (a)	6.8		9.0	9.0		8.5	9.1			8.1		
Kidney fat-percent (a)	1.5		1.8	2.6		2.8	2.5			1.9		
Ribeye area--sq. in.	9.8		10.6	10.6		10.0	10.5			10.3		
Ribeye area/100 lbs. carcass	2.19		2.01	2.34		2.06	2.36			2.42		
Shear--1" core	20.7		21.5	28.6		17.9	22.0			23.1		
Fat thickness-mm. (b)	2.8		6.8	7.6		7.5	7.6			6.9		
Fat thickness-in. (b)	0.12		0.27	0.30		0.30	0.30			0.27		
Carcass wt./day of age (lbs.)	1.06		1.24	1.05		1.18	1.02			0.99		

- (a) Estimated by grader (Dr. Auttis Mullins).
- (b) Measured from ribeye tracings at 3 places and averaged.
- (c) Weight at station just before shipping.
- (d) Weight at slaughter plant before slaughter.

Table 6. Performance of Replacement Heifers Born in 1969. (18 months weight)

Breed	Angus	Angus	Angus	Angus	Angus	Brangus	Brangus
Study	Adapt.	Adapt.	Fat	Fat	Fat	Fat	Fat
Line	Closed	Outside	Hi	Lo	Hi	Lo	Lo
Number	13	8	10	14	23	17	
Avg. wt. (lbs.)	571	558	596	615	658	654	
Avg. age (days)	536	545	552	555	543	534	
Wt./day of age (lbs.)	1.06	1.02	1.08	1.11	1.21	1.22	
Fat, mm.	--	--	3.90	3.70	3.80	3.30	
Type (a)	11.20	11.80	11.10	10.90	10.10	9.40	
Condition (a)	7.90	8.50	8.30	7.90	7.70	6.70	

(a) Good = 9, 10, 11; Standard = 6, 7, 8.

Table 7. Performance of Replacement Heifers Born in 1970. (Yearling Weight)

Breed	Angus	Angus	Angus	Angus	Angus	Brangus	Brangus
Study	Adapt.	Adapt.	Fat	Fat	Fat	Fat	Fat
Line	Closed	Outside	Hi	Lo	Hi	Lo	Lo
Number	22	7	19	18	15	11	
Avg. wt. (lbs.)	379	353	415	419	455	447	
Avg. age (days)	359	368	364	377	363	349	
Wt./day of age (lbs.)	1.06	0.96	1.14	1.11	1.25	1.28	

Table 8. Cow Weights

Breed	Brangus	Brangus	Angus	Angus	Angus
Study	Fat	Fat	Fat	Adapt.	Adapt.
Line	Hi	Lo	Hi	Closed	Outside
Number	60	67	54	53	32
Weight (lbs.)	906	934	808	780	778

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Louisiana (Jeanerette)

Location		Jeanerette	Jeanerette	Jeanerette	Jeanerette	
Breed of sire		Angus	Angus	Angus	Angus	
Breed of dam		Angus	Angus	Angus	Angus	
Line or group <sup>1</sup>		Adapt. Closed	Adapt. Outside	Hi Fat	Lo Fat	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	52	32	51	62	
	Yearling Heifers	19	4	13	14	
	Bulls and steers under 1 year	19	15	24	31	
	Heifers under 1 year	17	9	17	22	
	Bulls over 1 year	9	0	9	9	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant <sup>2</sup>	85	82 <sup>x</sup>	80	82	
	Calf survival <sup>3</sup> percent	100	100	91	94	
Wean. perf.	Adj. ADG <sup>4</sup>	1.42	1.40	1.55	1.53	
	Av. type score <sup>5</sup>	11.4	10.8	11.3	10.7	
Postweaning performance	No. of bulls	15	11	10	15	
	No. of heifers	19	4	13	14	
	No. of steers	0	0	0	0	
Slaughtered	No. of bulls	10	8	6	10	
	No. of heifers	0	0	0	0	
	No. of steers	0	0	0	0	
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Louisiana (Jeanerette)

Location		Jeanerette	Jeanerette			
Breed of sire		Brangus	Brangus			
Breed of dam		Brangus	Brangus			
Line or group <sup>1</sup>		Hi Fat	Lo Fat			
Percent used in project		100	100			
Inventory as of July 1, 1971	Cows 2 years and over	58	54			
	Yearling Heifers	11	7			
	Bulls and steers under 1 year	24	21			
	Heifers under 1 year	19	18			
	Bulls over 1 year	9	8			
	Steers over 1 year	0	0			
Repro. perf.	Percent pregnant <sup>2</sup>	84	73			
	Calf survival <sup>3</sup> percent	87	90			
Wean. perf.	Adj. ADG <sup>4</sup>	1.82	1.80			
	Av. type score <sup>5</sup>	10.7	10.2			
Postweaning performance	No. of bulls	16	10			
	No. of heifers	11	7			
	No. of steers	0	0			
Slaughtered	No. of bulls	11	5			
	No. of heifers	0	0			
	No. of steers	0	0			
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

MISSISSIPPI STATE UNIVERSITY  
Agricultural Experiment Station  
State College, Mississippi

I. PROJECT: Hatch 3-207-666

A study to determine the breeding worth of inbred and outbred bulls from various sources.

II. OBJECTIVES:

To compare pre- and postweaning growth rates, market grades, carcass qualities and maternal ability of the progenies of potentially superior sires selected from various sources.

III. PERSONNEL: Fay Hagan and L. J. Smithson

IV. ACCOMPLISHMENTS DURING THE YEAR:

Calves sired by bulls from the four inbred (lines 1-4) and two single-trait selection lines (lines 7 and 8) of Angus were again produced. Not only were line bulls mated to random Angus dams, but they were mated to females which were produced in the project. Some of the calves born this year were the result of mating inbred sires to heifers from lines other than the sires! The number of "line" heifers now available to replace some of the random cows that have been used is approaching enough to make up six breeding groups. These numbers are shown in the following table.

Numbers of Heifers in the Herd.

Line	Year Born				Total Number
	1967	1968	1969	1970	
1	5	4	8	9	26
2	5	6	10	5	26
3	5	7	4	5	21
4	2	3	13	3	20
7 (type)	5	4	8	7	24
8 (growth)	4	4	7	6	17
Total	26	28	50	35	134

Performance data for pre- and postweaning intervals are presented below.

Prewaning Performance of 1970 Calf Crop.

Sire Line	Birth Weight <sup>a</sup>	A.D.G. <sup>a</sup>	Weaning Grade	210 day Weight <sup>a</sup>	% Cows Calving	% Cows Wng. Calves	No. of Calves
1	53.6	1.40	11	351	86.4	81.8	18
2	49.3	1.29	10	321	42.1	36.8	7
3	63.3	1.44	11	366	94.7	78.9	15
4	58.5	1.30	11	331	61.0	50.0	9
7(type)	63.8	1.42	11	362	100.0	100.0	17
8(growth)	64.6	1.39	12	355	68.0	68.0	15
Control	53.3	1.27	11	322	91.0	74.0	17

<sup>a</sup>Heifer calves adjusted to steer basis.

Steers born in 1970 were slaughtered June 24, 1971. They were on a wintering ration for 115 days and a finishing ration for 111 days.

Postweaning Performance of 1970 Steers.

Sire Line	Number of Steers	Wt. on Winter Ration	A.D.G. Winter Ration	Wt. on Finishing Ration	A.D.G. Finishing	Weight at Slaughter	Lb. Feed per lb. of Gain
1	5	351	1.37	509	2.17	729	9.956
2	2	368	2.12	612	2.02	810	11.677
3	5	431	1.39	591	2.15	824	10.166
4	5	319	1.75	520	2.10	740	10.523
7	5	420	1.58	602	1.74	814	12.567
8	5	408	1.66	599	2.40	873	11.262
Control	5	329	1.68	522	1.75	738	12.768

V. FUTURE PLANS:

The 1972 breeding season will be the last for this project.

VI. PUBLICATIONS DURING THE YEAR:

None.

VII. PUBLICATIONS PLANNED:

None.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Mississippi

Location		Prairie				
Breed of sire		Angus				
Breed of dam		Angus				
Line or group <sup>1</sup>						
Percent used in project		100				
Inventory as of July 1, 1971	Cows 2 years and over	169				
	Yearling Heifers	34				
	Bulls and steers under 1 year	60				
	Heifers under 1 year	52				
	Bulls over 1 year	12				
	Steers over 1 year	39				
Repro. perf.	Percent pregnant <sup>2</sup>	77.6				
	Calf survival <sup>3</sup> percent	90.1				
Wean. perf.	Adj. ADG <sup>4</sup>					
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers	37				
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	37				
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

NORTH CAROLINA STATE UNIVERSITY  
Agricultural Experiment Station  
Raleigh, North Carolina

I. PROJECT: Animal Science 1010

Direct and correlated response to selection for weaning weight and postweaning gain.

II. OBJECTIVES:

To measure the effectiveness of selection to increase 205-day weight and postweaning gain to 365 days and to evaluate correlated responses in other traits.

To investigate phenotypic and genetic relationships between growth and milk production.

III. PERSONNEL:

E. U. Dillard, O. W. Robison, J. E. Legates, J. J. Rutledge and T. N. Blumer

IV. ACCOMPLISHMENTS DURING THE YEAR:

Project prosecution was according to plan. Since this is a long time selection response study, definitive results are not anticipated in the early years. Calves born in 1970 were the first group to be born of selected sires. Reproductive performance of the herd has been such that selection among cows has not been possible.

Semen was collected and frozen from the 1969 bulls when they were approximately two years of age. As in previous years some difficulty was experienced in obtaining satisfactory ejaculates, but based upon early information all of the sires being used seem to be fertile.

Seventy-two bulls completed the postweaning gain phase of the experiment in 1970-71 and carcass data were obtained upon 55 that were slaughtered at the end of the test. By slaughtering these bulls at 12-14 months of age we have had very little opposition from the packer to paying steer prices and the taste panel doing the meat evaluation work does not report objectionable flavor.

V. FUTURE PLANS:

The selection study will be continued according to plan.

VI. PUBLICATIONS:

Vesely, J. A. and O. W. Robison. 1971. Genetic and maternal effects on preweaning growth and type score in beef calves. J. Anim. Sci. 32:825-831.

Vesely, J. A. and O. W. Robison. Conventional selection indexes for birth and weaning traits in beef calves. (In press.)

Rutledge, J. J., O. W. Robison, W. T. Ahlschwede and J. E. Legates. Milk yield and its influence on 205-day weight of beef calves. (In press.)

VII. PUBLICATIONS PLANNED:

Three additional publications have been submitted to the Journal of Animal Science for review.

VIII. COOPERATING AGENCIES:

North Carolina Department of Agriculture

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State North Carolina

Location		Plymouth	Raleigh			
Breed of sire		Hereford	Hereford			
Breed of dam		Hereford	Hereford			
Line or group <sup>1</sup>						
Percent used in project		100	100			
Inventory as of July 1, 1971	Cows 2 years and over	110	102			
	Yearling Heifers	33	32			
	Bulls and steers under 1 year	53	33			
	Heifers under 1 year	43	42			
	Bulls over 1 year		29			
	Steers over 1 year					
Repro. perf.	(1969 breeding) Percent pregnant <sup>2</sup>	61	62			
	(1970 calving) Calf survival <sup>3</sup> percent	90	81			
Wean. perf.	Adj. ADG <sup>4</sup>	1.45	1.73			
	Av. type score <sup>5</sup>	9.90	9.90			
Postweaning performance	No. of bulls <sup>6</sup>	48	24			
	No. of heifers <sup>6</sup>	34	32			
	No. of steers					
Slaughtered	No. of bulls <sup>6</sup>	35	20			
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments: Adjusted to mature cow and steer basis.
- 5 - Suggest S-10 scoring system; indicate if different.
- 6 - Number animals completing test.

I. PROJECT: Animal Science 5201

Evaluation of rotational corssbreeding of Angus, Charolais and Hereford for beef production.

II. OBJECTIVES:

To compare a three-breed rotational crossbreeding program with straightbreeding of Hereford cattle for (1) fertility, (2) calf viability, (3) weaning weight, (4) feed lot and carcass merit and (5) mature weight.

III. PERSONNEL:

E. U. Dillard, J. E. Legates and T. N. Blumer

IV. ACCOMPLISHMENTS DURING THE YEAR:

Two hundred and eighty-five calves were weaned in the two herds participating in the crossbreeding study in 1970. Not all calves correspond to the rotational cross due to the fact that in these herds artificial insemination is practiced for about 40-45 days and then clean up bulls are used. Adjusted 205-day weights were 424 and 447 pounds for the two herds. In each herd the mean adjusted 205-day weights were heaviest for rotational cross calves out of three-breed-cross dams followed by the three-breed calves out of single cross dams, then single cross calves and lowest were the grade Hereford calves which serve as a control or breed for comparison.

Comparisons between the straightbred Herefords and certain of the crosses have been possible each year since 1963. The total number of calves weaned through the 1970 season is indicated in the following table for the various breed groups together with the average difference in 205-day weight between the grade Hereford and the various crosses.

MEAN DIFFERENCE IN 205-DAY ADJUSTED WEIGHT  
OF CALVES BY BREEDING

Breed	No.	Average Difference, pounds
Hereford	431	
Angus x Hereford	352	+33
Charolais x (A x H)	335	+56
A x Ch x AH	71	+63
H x Ch x AH	79	+71

Weights have been taken on many, but not all, heifers at 12-15 months of age. Some selection of replacement heifers takes place at weaning and thus all are not present as yearlings. The weight difference between the A x H and three-breed

cross heifers at 12-15 months when compared to straightbred Herefords is much the same as at weaning, however, the heifers in the second cycle of crossing have shown only about 15-20 pounds advantage in weight over the Hereford heifers. While the number of animals represented here is not large, there is some indication that daughters of the three-breed cross cows do not continue to gain as well after weaning as before. This may indicate that the three-breed cross cows were good milkers and the calves lost some of their "milk fat" after weaning.

#### Crossbred Steer Performance

Beginning with the 1967 calves, 20 steers from each Butner and Morganton are being fed for a 140-day postweaning period in Raleigh. Steers for 1967, 1968 and 1969 were brought to Raleigh at weaning in the fall and were slaughtered the following spring. Each group of 20 steers (18 in 1969) was chosen to include 5 straightbred Hereford steers and 5 crossbred steers sired by each Charolais, Hereford and Angus bulls. As the breeding system progresses the crossbred steers chosen will represent calves sired by the three breeds of bulls out of three-breed crossbred cows. Sufficient three-breed crossbred steers were not available in 1967 or 1968 to fill the groups, hence some intermediate crosses were chosen.

Means of the breed groups adjusted for year and location effects are shown in the following table. Rib eye area and average fat thickness are not adjusted for carcass weight. Breed groups were significantly different for shrunk weight, hot carcass weight and rib eye area.

#### POSTWEANING PERFORMANCE STEERS<sup>a</sup>

Breed or Cross	No.	Final Weight (lbs.)	ADG on Test	Carcass Weight (lbs.)	Rib Eye Area (sq. in.)	Rind Thickness
Hereford	20	911	2.41	525	9.35	0.63
F <sub>1</sub> Crosses	25	917	2.45	534	10.40	0.50
3-breed Crosses	31	927	2.53	548	10.57	0.57
2nd Rotation	26	938	2.60	552	10.66	0.63

<sup>a</sup>Values are least squares means - values adjusted for certain environmental influences including herds and years and for differences in initial weight at start of test.

#### V. FUTURE PLANS:

Matings will continue as planned. Hereford and Angus sires have entered the rotation for the second time and the project will continue until all breeds have entered at least twice through sires.

#### VI. PUBLICATIONS:

None

VIII. COOPERATING AGENCIES:

North Carolina Hospital Board of Mental Health

(Beef herds located at Broughton Hospital, Morganton, North Carolina, and John Umstead Hospital, Butner, North Carolina.)

CLEMSON UNIVERSITY  
Agricultural Experiment Station  
Clemson, South Carolina

I. PROJECT:

The response of sire progenies to management and feeding procedures.

II. OBJECTIVES:

To investigate the response of sire progenies, as measured by live animal and carcass traits to methods of producing slaughter cattle.

To evaluate the magnitude and importance of the average genotype with certain environmental influences.

To develop, through selection, herds of beef cattle with superior performance under South Carolina conditions.

III. PERSONNEL:

W. C. Godley, J. R. Hill, Jr., G. C. Skelley, Jr., R. M. Rauton, and R. F. Wheeler.

IV. ACCOMPLISHMENTS DURING THE YEAR:

One hundred fifty-six Angus cows were bred to produce the 1970 calf crop. Only 75.8% of these cows weaned a live calf. Thirteen percent of the cows calving had calves that were dead at birth or died within the first 36 hours after calving. These results emphasize the need for additional research into the causes of dystocia and death at or near calving.

All cows failing to conceive were slaughtered to determine the incidence of abnormalities that may influence reproductive performance. The results of this study indicate that most reproductive failure is due to causes other than abnormalities.

V. FUTURE PLANS:

A new project is being planned and will include only the Angus cattle.

VI. PUBLICATIONS DURING THE YEAR:

Hill, James Riley, Jr. and D. R. Lamond. 1970. Causes of Reproductive failure in beef cattle. J. Anim. Sci. 31:223 (Abstr.).

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State South Carolina

Location		Clemson				
Breed of sire		Angus				
Breed of dam		Angus				
Line or group <sup>1</sup>		Purebred				
Percent used in project		100				
Inventory as of July 1, 1971	Cows 2 years and over	129				
	Yearling Heifers	40				
	Bulls and steers under 1 year	64				
	Heifers under 1 year	64				
	Bulls over 1 year	21				
	Steers over 1 year	0				
Repro. perf.	Percent pregnant <sup>2</sup>	90.85%				
	Calf survival <sup>3</sup> percent	83.56%				
Wean. perf.	Adj. ADG <sup>4</sup>	1.95				
	Av. type score <sup>5</sup>	12.20				
Postweaning performance	No. of bulls	8				
	No. of heifers	46				
	No. of steers	56				
Slaughtered	No. of bulls	0				
	No. of heifers	0				
	No. of steers	56				
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

UNIVERSITY OF TENNESSEE  
Agricultural Experiment Station  
Knoxville, Tennessee

I. PROJECT: H-306 (S-10)

Effects of selection to improve growth rate in beef cattle.

II. OBJECTIVES:

1. To measure the effectiveness of selection to improve growth rate to a year of age and the effects such selection will have on other traits.
2. To investigate phenotypic and genetic relationship between growth rate and other variables.
3. To investigate various methods of improving the accuracy of assessment of growth rate.
4. To study inbred beef cattle with the aid of immunogenetic markers.

III. PERSONNEL:

R. R. Shrode, C. S. Hobbs, J. A. Odom, J. H. Felts and W. T. Butts, Jr.

IV. ACCOMPLISHMENTS DURING THE YEAR:

Analyses of body measurement data were continued adding data accumulated since those included in the analyses completed and reported last year with special attention being given age trends in body measurements. These analyses have not yet reached a reporting stage.

Shipment of blood samples for blood typing of the Angus herd was continued to the point of reaching a current status before July 1. That is, shipments made during the remainder of the year will include only samples from 1971 calves, samples from all of these to be shipped before January 1, 1972.

Scores for rebelliousness in the chute were recorded for 1970 calves when yearling data were collected in March. Effects of sire, sex and sire x sex interaction were tested. The only significant effect found was that of sire in the Angus herd. In fact, this was the only test yielding an F value greater than 1.0. Sampling errors were appreciable, the heritability estimate obtained being  $0.40 \pm 0.30$ .

V. FUTURE PLANS:

Continuation of planned procedures and accumulation of data to contribute to accomplishments of the stated objectives.

VI. PUBLICATIONS DURING THE YEAR:

Brown, W. L. and R. R. Shrode, 1971. Body measurements of beef calves and traits of their dams to predict calf performance and body composition as indicated by fat thickness and condition score. J. Animal Sci. 32 (In Press).

Shrode, R. R. and S. P. Hammack. 1971. Chute behavior of yearling beef cattle. J. Anim. Sci. 32 (Abstr.).

## VII. PUBLICATIONS PLANNED:

Shrode, R. R. et al. Age trends in various body measurements of young beef cattle.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Tennessee

Location		PES	PES	TES		
Breed of sire		Angus	Angus	P. Hereford		
Breed of dam		Angus	Angus	P. Hereford		
Line or group <sup>1</sup>		Inbred	Non-Inbred	Non-Inbred		
Percent used in project		100%	100%	100%		
Inventory as of July 1.	Cows 2 years and over	54	134	87		
	Yearling Heifers	16	38	26		
	Bulls and steers under 1 year	13	55	48		
	Heifers under 1 year	15	41	33		
	Bulls over 1 year	20	51	12		
	Steers over 1 year	-	-	-		
Repro. perf.	Percent pregnant <sup>2</sup>	65	79	96		
	Calf survival <sup>3</sup> percent	76	90	95		
Wean. perf.	Adj. ADG <sup>4</sup>	1.88	1.99	1.71		
	Av. type score <sup>5</sup>	13.20	13.60	12.60		
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

TEXAS A&M UNIVERSITY  
Agricultural Experiment Station  
College Station, Texas

I. PROJECT: S-1547

Genetics of qualitative characters in beef cattle.

II. OBJECTIVES:

To estimate genetic parameters and genetic-environmental interactions of biological and economic traits.

III. PERSONNEL:

D. F. Weseli (leader), Jerry Caldwell and T. C. Cartwright

IV. ACCOMPLISHMENTS DURING THE YEAR:

Blood typing cattle in the S-10 project herds. Most mature animals in the McGregor, Texas; Texas A&M; Front Royal, Virginia; and Crossville, Tennessee S-10 cooperative herds have been blood typed. New animals entering the herds are being typed on a regular basis. All cooperating herds are reasonably current except no sires from the Tennessee herd have been typed.

Development of red cell typing reagents. Several new and valuable reagents were added during the year. The quality of the test procedure for red cell typing improved. Attempts will be made to maintain the reagent bank and make further improvements, but it will not be a major portion of the work load.

Preparation of data for analysis. All accumulated data are now being entered on IBM cards. Copies of the data on all animals will then be available for data analysis. Listing and summary programs for the immunogenetics data have been written so that listings can be sent to cooperating stations at regular intervals to replace the duplicate hand-written cards.

Transferrin and hemoglobin analyses. Analyses for these proteins were started on samples submitted by Virginia and Tennessee after January 1971. Previously only samples from McGregor, Texas were typed for these systems. Starch gel electrophoresis is being used for transferrin analysis and Microzone electrophoresis for hemoglobin analysis.

V. FUTURE PLANS:

Blood typing, transferrin and hemoglobin typing of animals in cooperating S-10 herds of Texas, Virginia and Tennessee will continue. Most of the current data should be on IBM cards by August, 1971. The data will also be entered onto an IBM disk pack for ease in updating, eliminating duplicate animal numbers and analysing the data.

A major new undertaking (already underway) will be a study of feasibility of determining isozyme variants in cattle blood. Initial efforts will concentrate on enzymes with a high probability of having physiological significance. This is a relatively unexplored research area in cattle, although it has produced some spectacular results in other species.

An investigation has been started to determine the possibilities of influencing the sex ratio in cattle by immunological and enzymatic techniques. The initial experiments will be an attempt to develop antibodies which will selectively react with sperm of one type. This project will also include a study of enzyme activity in spermatozoa.

A separate project statement which has been prepared for this work will be submitted for review during the Summer of 1971.

VI. PUBLICATIONS:

Caldwell, J., D. F. Weseli and T. C. Cartwright. 1971. Occurrence of  $\alpha_{s1}$ - and  $\beta$ -casein types in five breeds of beef cattle. J. Anim. Sci. 32:601.

VII. PUBLICATIONS PLANNED:

Amino acid analysis of  $\alpha_{s1}$ - and  $\beta$ -caseins in Hereford and Brahman cattle.

Gene frequency and genetic associations of serum transferrins and hemoglobins in beef cattle.

Use of blood typing to determine the actual sire in multiple bull breeding lots.

I. PROJECT: H-2101

Breeding methods for beef cattle in the southern region.

II. OBJECTIVES:

To estimate genetic parameters and genetic-environmental interactions of biological and economic traits.

III. PERSONNEL:

T. C. Cartwright (leader), H. A. Fitzhugh, Jr., and R. C. Thomas

IV. ACCOMPLISHMENTS DURING THE YEAR:

The results of this project and its predecessor have dealt with growth characters and with hybrid vigor. Ramifications of these results lead to considerations of efficiency of the growing calf (for which project S-1359 "Sources of Variation in Efficiency of Feed Use in Drylot By Young Beef Cattle" was established) and the efficiency of correlated effects in the cow (for which project 1583 "Efficiency of Beef Production as Affected by Body Size and Breed of Dam" was established). Basic to the understanding of growth and efficient genetic utilization and manipulation of growth is knowledge of the growth pattern for individuals, breeds, sexes, etc. Several studies have yielded workable models which include:

$$Y_t = M(1 - e^{-kt})$$

$Y_t$  = size at age  $t$  (or weight at age  $t$ )

$M$  = mature size at  $t = \infty$

$K$  = maturing index or measure of rate of change

$$Y_t = Y_0 e^{A/\alpha(1 - e^{-\alpha t})}$$

$A$  = initial proliferation rate of body mass

$\alpha$  = rate at which asymptotic (mature) weight is reached.

Among the conclusions and interpretations these curves have yielded include:

1. Genetic correlation between  $M$  and  $K$  was estimated as  $-0.9$ ; i.e., there is a very strong tendency for stages of maturity to be reached at older ages as mature size is increased. Selection for growth rate would be expected to increase ADG and mature size and decrease rate of maturity but have little if any effect on intrinsic feed efficiency. Selection for growth rate while restricting mature size would be expected to increase ADG, earliness of maturity and feed efficiency.
2. Genetic, environmental phenotypic correlations between  $A$  and  $\alpha$  exceeded  $0.93$ . Again indicating heavier mature individuals mature more slowly. Puberty, within a genotype, tends to be weight constant rather than age constant.

3. Cows with large A values (large mature size) tended to wean heavier calves, to have longer calving intervals and produce fewer calves per year. Cows with large K values (early maturing cows) tended to have shorter calving intervals and to produce more calves. The correlation between no. calves weaned/year and A was  $-.235$  while with K it was  $0.362$ .
4. Cattle with genotypes for different M values (and correlated parameters), reach optimum weight for slaughter at different ages and weights. An extension of these results can be applied to determine optimum sale weight of cattle in the feedlot.

### Breeding Systems

In order to integrate the clarifications and understandings which have come out of the studies of growth curves with utilization of hybrid vigor, linear programming techniques have been applied. These techniques have been used to compare different selection and breeding systems on the basis of total or overall efficiency of utilization of base resources. Examples of results are:

1. A three breed crossing system utilizing  $F_1$  cows from small breeds crossed with bulls of a large breed (Angus-Jersey x Charolais) is more efficient in total nutrient utilization than a straight breed (Angus) when replacement problem (such as small  $F_1$  A-J steers) and other inputs and outputs are considered.
2. A small breed or herd within a breed (mature weight = 942 lb.) is more efficient than either a large breed or herd within a breed (mature weight = 1334 lb.) or an intermediate size breed or herd within a breed (mature wt. = 1138 lb.).

Since development of crossbreeding programs involves large sums of capital and long periods of time, polyperiod models were developed to more realistically determine efficient methods of utilizing hybrid cattle. In one simulated study the primary basis for evaluation was the economic efficiency of utilization of fixed nutrient resources. A dynamic polyperiod model for commercial beef production included the options of straightbreeding, producing and breeding  $F_1$ 's and three-breed rotational crossing. Linear programming techniques were used to establish the most efficient system. Weight data for contemporary Angus, Hereford and Brown Swiss-Hereford cattle in the herd at McGregor were used to simulate growth curves. Average estimates of heterosis for fertility and calf survivability were obtained from the literature. Nutrient requirements for growth, maintenance, lactation and reproduction were based on NRC recommendation. Least-cost diets for cattle were balanced on dry matter, metabolizable energy, digestible protein, calcium and phosphorous. The age composition of the initial straightbred herd was 19% 2-year-olds, 18% 3-year-olds, 17% 4-year-olds and 46% 5 years and older. The normal attrition rates for straightbred cows by age group were assumed to be 10% of 2-year-olds, 5% of 3's, 5% of 4's and 25% for the total group 5 years and older. Two-breed cross heifers generally replaced straightbred cows; however, these replacement rates did not exceed the normal attrition rates for straightbred cattle. Three-breed heifers which were heavier, had higher milk yield potential and required more nutrients, were generally not used as replacements but, instead, were sold for slaughter.

A principal components analysis was performed on measures of cow size. Thirty-eight Hereford cows, aged 5 to 9 years, from the McGregor herd were measured in one or more of three consecutive years. Measures of size were chest depth (CD) and hood width (HW) by calipers, body length (BL) by tape and the average of biweekly body weight (AW) taken during the period between successive parturitions. Linear measures were taken each year when progeny were weaned. Correlations among these four measures of size were calculated separately for data collected each year and also pooled within-years. The principal components for each of these four correlation matrices were evaluated. Repeatability across years was 0.85 for the first component and 0.00 for the second component. The component associated with the largest root of the pooled, within-year matrix accounted for 75% of the generalized variance and was interpreted as a general size factor. Coefficients for the first component were: AW, 0.5376; CD, 0.5335; HW, 0.5012 and BL, 0.4185. The second component for the pooled within-year matrix appeared to be primarily a contrast between HW and BL and may also reflect differences in condition. Coefficients for the second component were: AW, 0.0232; CD, 0.2114; HW, 0.4668 and BL, -0.8584. The first and second components together accounted for 90% of the generalized variance. Correlations of the four variables with the general size component were high (AW, 0.93; CD, 0.92; HW, 0.87; BL, 0.72). Correlations of cow's weight at birth, 180 days and 365 days with the general size component were 0.03, 0.28 and 0.50, respectively.

In earlier studies, the relationship between time taken to mature and mature size has generally been investigated by interrelating growth curve parameters. An alternative approach involving the direct analysis of age at a constant degree of maturity and requiring no assumptions as to the form of growth curve is described. This method is applied to the results of a within-breed growth study on beef cattle given by Brinks et al. (1964).

Estimates of heritabilities for time taken to mature in body weight ranged from 0.22 at birth to 0.42 at 18 months of age. Inter-age correlations were high, with animals early maturing at any given stage tending to be early maturing at all later stages. Animals reaching a constant degree of maturity at an earlier than average age tended to be slightly heavier than average. The average genetic coefficient of variation for time taken to mature was 4.2%. Therefore, most cattle attained the same degree of maturity for body weight at some time in the age interval extending about 3 weeks before and after birth. Similarly, most animals were equally mature at some time in the age interval extending about 2 months before and after 18 months of age.

The genetic correlations between time taken to mature and mature weight were 0.34, 0.41, 0.39 and 0.39 at birth, 6, 12 and 18 months of age, and that for mean time taken to mature was 0.48. Thus, within a breed, animals genetically heavier at maturity tended to take a longer time to mature in body weight. Estimates of the genetic regression of time taken to mature on mature weights were 0.23, 0.33, 0.28, and 0.26 at birth, 6, 12 and 18 months of age, and 0.28 for mean time taken to mature. The age at which an individual reached a given degree of maturity thus tended to be proportional to about the 0.3 power of its mature weight. This within-breed result is virtually the same as that found previously for species, breeds and sexes. The association, therefore, appears to be an inherent feature of growth.

The heritability of 0.37 for time taken to mature was only slightly reduced to 0.35 when mature weight was held constant. Moreover, only about 22% of genetic

variation in mean time taken to mature was associated with mature weight. Within-breed selection for time taken to mature should therefore be reasonably effective even with mature weight held constant.

Size at any age can be partitioned into two components: one expressing the extent of proportionality to mature size and the other measuring the extent of deviation from this proportionality, which result from individual differences in maturing rate. A general method of analyzing genetic relationships involving maturing rate, size, growth rate and other traits in terms of degree of maturity was developed as an alternative to estimating such relationships from the parameters of fitted growth curves.. This method was applied to the results of a within-breed growth analysis published by Brinks et al. (1964) on body weight of beef females at 5 ages from birth to maturity.

During the main period of growth, there was almost as much genetic variation in degree of maturity as in body weight itself, and heritabilities also were similar. High inter-age genetic correlations for degree of maturity showed that animals more mature in body weight at any age tended to be more mature at other ages as well. Genetic correlations between body weight and degree of maturity at the same age indicated that selection for weight at a given age will result in making animals somewhat more mature on average at that age and adjacent ages. However, animals heavier than average at maturity tended to be less mature than average at all immature stages. Genetic covariation with mature weight accounted for only about 15% of the total genetic variation in degree of maturity. Hence among animals of similar mature weight there remained a considerable amount of genetic variation in degree of maturity at earlier ages.

Heritability estimates for absolute rate of maturing varied from 0.22 to 0.46, as did those for relative maturing rate. Animals maturing rapidly at early ages tended to mature slowly at later ages.

Selection for increased degree of maturity at any age would tend to increase both absolute and relative growth rate at early ages (<12 months) and decrease them at later ages. Selection for increased body weight at any age, on the other hand, would result in animals with a much higher absolute growth rate at most stages; but their absolute relative maturing rates would be only slightly higher than average at the age of selection and lower than average at ages widely separated from the age of selection.

#### Performance of exotic sires in Argentina

The beef production potential of a series of breeds, including several not yet available in the U.S., is being evaluated in a cooperative project between the Texas station and the Instituto Nacional de Tecnologia Agropecuaria (INTA) of Argentina. Data collected by INTA will be analyzed in Texas and both groups will contribute to interpretation and publication of results.

The research was initiated in 1960 at the Balcarce Experiment Station located southwest of Buenos Aires in the Pampa area. Emphasis in the first five years was placed on comparison of calves by Angus, Hereford, Shorthorn and Charolais bulls bred to Angus, Hereford and Shorthorn cows. Subsequently, frozen semen from European A.I. centers was obtained for Schwarzbunte, Rotbunte, Gelbvieh and Fleckvieh sires (Germany); Chianina, Piemontese and Romagnola sires (Italy);

Least-Squares Means By Sire Breed For Weights At Birth And Weaning, kg<sup>1</sup>

Sire Breed	No.	BW	WW
M	906	34 ± .5	188 ± 2.5
Angus	162	29 ± .5	164 ± 2.8
Hereford	24	31 ± 1.1	174 ± 5.7
Shorthorn	24	31 ± 1.0	170 ± 5.6
Charolais	237	37 ± .5	197 ± 2.5
Chianina	6	37 ± 1.9	189 ± 10.1
Romagnola	13	36 ± 1.3	197 ± 7.2
Piemontesa	6	37 ± 2.0	206 ± 10.5
Fleckvieh	67	36 ± .8	197 ± 4.3
Gelbvieh	53	36 ± .9	191 ± 4.6
Schwarzbunte	37	33 ± .9	192 ± 4.8
Rotbunte	95	35 ± .7	195 ± 3.8
Garronais	55	35 ± .9	187 ± 4.6
Normande	40	36 ± .9	192 ± 4.8
Holstein	15	33 ± 1.3	185 ± 6.8
Brown Swiss	43	35 ± .9	187 ± 4.8
Angus x Charolais	29	32 ± 1.0	177 ± 5.6

<sup>1</sup>Analytical model included sex, birth year and month and location of birth.  
Only calves with Angus dams were included in this analysis.

Charolais, Garronais, Limousin and Normande sires (France). Other sire breeds which have also been evaluated include Argentine Holstein, Brown Swiss, Santa Gertrudis, Brahman and Angus x Charolais (F<sub>1</sub>). Several of the breeds have been tested only in the 1968 and later calf crops. The general procedure is that six sires per breed per year are each mated to five Angus cows. Additional matings with Hereford and Shorthorn cows were usually made.

Cows and calves are grazed on good quality pasture. Calves are weaned at 8 months and then the males (castrated 30 days after birth) and most females were grown on pasture with some energy and protein supplements prior to slaughter at approximately two years of age. Data collected on calves include 28-day weights from birth to slaughter and an extensive set of qualitative and quantitative carcass traits.

Results of preliminary analyses of weights at birth and weaning for cattle born at Balcarce between 1960 and 1967 are shown in the accompanying table. Dystocia has not been a problem with any sire breed, even with first-calf heifers. This lack of calving difficulty has been attributed by the Argentine scientists to a regime of limited nutrition during gestation.

Data on gestation length of calves born out of Aberdeen Angus cows and Brahman Romagnola (RM), Santa Gertrudis (SG), Garronais (DA), Gelbvieh (GE), Charolais (C), Fleckvieh (F), Argentine Holstein (H), F<sub>1</sub> Angus x Charolais (AC), Schwartzbunte (S), Angus (A) and Rotbunte (RB) sires were analyzed in Argentina. The mathematical model included sex, age of dam, year of birth and breed of sire. Data were obtained under two management systems, for the first one (R7) 3 years data were available, while the second (R6) included only one year. The main difference between the systems was a restriction of during the 7th and 9th month of the first pregnancy and between the 3rd and 6th month of the second. The average length of 518 gestations for system R7 for each breed of sire were: B, 290.3; RM, 285.7; SG, 285.3; GA, 283.9; GE, 282.8; C, 282.2; F, 282.0; H, 280.9; AC, 280.3; S, 279.2; A, 278.7 and RB, 277.8 days. Age of dam and breed of sire were significant ( $P < 0.05$ ). The analysis for system R6 included 197 calves born. The breeds of sires were: Romagnola (RM), Charolais (C), Chianina (CN), Limousin (L), Piemontesa (P) and Argentine Holstein (H). Averages for breed of sire were: RM, 289.1; C, 288.0; CN 286.0; L, 285.9; P, 285.5; and H, 281.2 days. The difference between R7 and R6 was 5.4 days and between sexes within R6 as 2.1 days. ( $P < 0.05$ ). An interaction between nutritional level and gestation length accompanied by prenatal compensatory growth effect might be present. (Data presented in this paragraph were reported by G. E. Joandet and A. A. Arias at III Reunion Latinoamericana de Produccion Animal, 1971, Bogota, Columbia).

#### V. FUTURE PLANS:

The facilities for beef cattle research will be substantially increased at McGregor beginning during the late Summer or early Fall of 1971. Plans call for termination of H-2101 and replacement by a new project principally oriented around evaluation of hybrid systems for total efficiency of beef production. A modified diallele design will be proposed.

Increased emphasis will be placed on use of data from current S-10 projects for simulating breeding systems. Polyperiod models will be extended and developed.

take into consideration dynamic populations. Results of these studies will be used for identifying research needs and setting priorities as well as serving as a base for making current recommendations.

#### VI. PUBLICATIONS DURING THE YEAR:

- Brown, J. E. 1971. A comparison of five stochastic models on their ability to describe the weight-age relationship in cattle. Texas A&M University. Ph.D. Dissertation.
- Brown, J. E. and T. C. Cartwright. 1969. Combining ability for postweaning gain. J. Anim. Sci. 29:105. (Abstr.).
- Brown, J. E., T. C. Cartwright and R. C. Thomas. 1971. Combining breeds for feedlot gain. Beef Cattle Research In Texas, 1971. Consolidated P.R.\_\_\_\_\_.
- Brown, J. E., H. A. Fitzhugh, Jr. and T. C. Cartwright. 1971. Comparison of weight-age models for cattle. J. Anim. Sci. 31:372. (Abstr.).
- Brown, J. E., H. A. Fitzhugh, Jr. and T. C. Cartwright. 1971. Correlations among lifetime weight-age statistics. J. Anim. Sci. 31:373. (Abstr.).
- Brown, J. E., H. A. Fitzhugh, Jr., T. C. Cartwright, S. E. Carpenter and E. R. Crouch. 1971. Algebraic models for describing growth of cows. Beef Cattle Research In Texas. Consolidated P.R.\_\_\_\_\_.
- Carpenter, J. A., Jr., J. E. Brown and H. A. Fitzhugh, Jr. 1971. Growth curve parameters and productivity of beef cows. J. Anim. Sci. 31:374. (Abstr.).
- Carpenter, J. A., Jr., H. A. Fitzhugh, Jr., T. C. Cartwright, A. A. Melton and R. C. Thomas. 1971. Principal components for size of Hereford cows. J. Anim. Sci. 32:\_\_\_\_\_ (Abstr.).
- Cartwright, T. C., J. E. Brown and R. C. Thomas. 1971. Combining breeds for 180-day weight. Beef Cattle Research In Texas. 1971. Consolidated P.R.\_\_\_\_\_.
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- Long, C. R., H. A. Fitzhugh, Jr. and T. C. Cartwright. 1971. Factors affecting efficiency of beef production. J. Anim. Sci. 31:384. (Abstr.).
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I. PROJECT:H-2102

Breeding methods for beef cattle in the southern region.

II. OBJECTIVES:

To estimate genetic parameters and genetic-environmental interactions of biological and economic traits.

III. PERSONNEL:

Nat M. Kieffer (leader) and T. C. Cartwright.

IV. ACCOMPLISHMENTS DURING THE YEAR:

The influence of certain androgenic substances on sex differentiation has been investigated by injecting the androgenic materials into the uterus of ewes via laparotomy at varying intervals following breeding.

Chromosomal analysis revealed that 7 of 11 phenotypic male lambs produced were actually genetic females. Only 3 of 10 genetic females had the corresponding phenotypic sex. The mothers of the 3 genetic females whose phenotypic sex was also female were either treated early post-breeding or late post-breeding as compared with other ewes in the experiment. The genetic females with male phenotypes differed primarily from genetic males in that the scrotum did not contain testes. Otherwise the external presentation of the urogenital system was that of a normal male.

Two genetic females with male phenotypes have been sacrificed to examine the internal reproductive organs. The first lamb examined had ovaries (slightly enlarged) and a normally formed uterus. The vagina ended blindly into the wall of the penis deep within the pelvic cavity. Histologically, only ovarian tissue was present in the ovaries. The second lamb sacrificed had internal reproductive organs similar to those of the first lamb with the exception that they were much smaller. Histological examination of the gonads showed that they were a mixture ovarian and testicular tissue and hence were ovotestes.

V. PLANS FOR THE FUTURE:

A similar experiment to the one described above is currently underway using both sheep and swine. Based on results obtained in the first study, time and amounts of androgen injections will be changed to produce maximum control of sex differentiation.

VI. PUBLICATIONS:

Kieffer, Nat M. and A. M. Sorenson, Jr. 1971. Some cytogenetic aspects of intersexuality in the bovine. J. Anim. Sci. 32:1219.

Kieffer, Nat M., Norman Judge and Stuart Burns. 1970. Some cytogenetic aspects of an Equus caballus intersex. Proceedings of the 1970 Somatic Cell Genetics Conference. (Abstr.).

I. PROJECT: 1646

Qualitative genetic differences in cattle and pleiotropic effects.

II. OBJECTIVES:

The specific research being conducted under the above project is entitled "Characterization of the double muscle syndrome: Its genetics, anatomy, physiology, meat chemistry and carcass qualities". The objectives are:

1. To determine the number of gene pairs involved in the transmission of the double muscle syndrome and the degree to which modifying genes may alter the action of the basic genes involved.
2. To delineate all traits comprising the double muscle syndrome as to their nature, interrelationships, concomitance and effect on the overall fitness of the individual.
3. To elucidate muscle chemistry, physiology and meat quality.
4. To study musculature of double muscled animals in quest of consistent departures from normalcy other than in size. The skeletal attachments, nerve innervation and relative blood supply of the muscles will be examined in detail.

III. PERSONNEL:

N. M. Kieffer (leader) and T. C. Cartwright

IV. ACCOMPLISHMENTS DURING THE YEAR:

Genetics

Twelve calves have been produced from mating double muscled cows to a double muscled bull. All calves exhibited some symptoms of the double muscle syndrome. Although there was considerable variation in the degree of expression, the trait most common to all calves was the marked increase in the mass of the muscles comprising the rear quarters and the loin. These results suggest that the genetic mechanism responsible for the double muscle syndrome is basically of a recessive nature. However, due to the variability among "homozygotes" and the expression of some aspects of the trait in "heterozygotes", the double muscle gene(s) is(are) incompletely recessive and the expression of the gene(s) may be influenced considerably by modifying genes.

The double muscle cow herd consists of Charolais, Santa Gertrudis, Red Polled and Angus cows. All cows when mated to a double muscled Charolais bull have produced double muscled calves, indicating the allelic nature of the gene(s) between the Charolais breed and the other breeds of cows in the herd.

Reproduction

Table 1 shows the reproductive performance of nine double muscled cows when mated to a Charolais bull. The three surviving calves were taken by Caesarean section.

Table 1. Reproductive Performance Of A Herd Of Doubled Muscle Cows Mated To A Doubled Muscle Bull

Cow No.	Breed	Phenotype of calf	Birth wt.(kg)	Sex	Remarks
931	S.G.	Dm	40.9	F	Pulled, Lived 30 min.
932	S.G.	Dm	50.0	M	Caesarean section, weak birth
933	S.G.	Dm	25.0	M	Unassisted birth, lived 30 days
934	S.G.	Dm	----	M	Pulled, dead
934	S.G.	Dm	50.0	M	Pulled, dead
935	Char.	Dm	45.4	M	Pulled, dead
935	Char.	Dm	56.8	F	Calved unassisted, calf dead
936	S.G.	Dm	39.5	F	Pulled, dead
937	S.G.	Dm	41.8	M	Calf pulled dead, Cow died 2 days later
938	S.G.	Dm	25.0	F	Caesarean section
938	S.G.	Dm	50.0	M	Caesarean section
940	R. Polled	Dm	45.4	M	Caesarean section, lived 1 hour

Even when dystocia is circumvented as in the case of Caesarean birth, viability of the doubled muscle calf is low for the first few hours after birth. The administration of oxygen and sodium bicarbonate to raise the blood pH seem to enhance livability. Studies of gaseous exchanges in the blood will be continued.

### Muscle Morphology

Histological examination of muscle sections from the longissimus dorsi, semiten-dinosus and biceps femoris showed that the muscle fibers were larger in the double muscled animal. This finding supports the explanation of increased muscular mass as being due to hypertrophy of the muscle fibers.

### Anatomy

Partial dissection of three doubled muscle animals has shown that the origin and insertion of muscles are normal in all respects. All muscles of the body are hypertrophied, although those of the proximal portion of the rear limbs are more prominent.

### Carcass Characteristics

Four steers were slaughtered in the latter part of January, 1971 after having been on feed for 196 days. Steers number 235, 253 and 229 were produced by mating a double muscle bull to conventionally muscled cows. Steer no. 260 was produced from mating a conventional muscled bull to a conventional muscled cow. Steers number 235, 253 and 229 were normal muscled phenotypically, whereas steer no. 260 showed marked double muscle characteristics. Table no. 2 presents certain carcass information on these steers. It is interesting to note that steer no. 260 had a higher yield of lean meat and a smaller percent of fat than did the other steers. Both USDA Yield and Quality grades reflect increased muscle and decreased fat production in the double muscled animal when compared with conventional muscled animals.

## V. PUBLICATIONS:

Kieffer, Nat M. and T. C. Cartwright. 1970. Inherited defects in cattle.  
Charolais Banner. Vol. 6, No. 6:188.

Table 2

Animal No.	235	253	229	260
Slaughter Date	1/19/71	1/20/71	1/21/71	1/22/71
Live wt. (lbs)	743	726	850	738
Carcass wt. (lbs)	452	437	509	477
Dressing %	61.58	60.19	59.88	64.63
Conformation Grade <sup>1</sup>	C-	G+	G+	C-
Maturity <sup>2</sup>	A	A-	A	A-
Marbling <sup>3</sup>	Mt	Sl <sup>0</sup>	Tr <sup>+</sup>	Sl
Quality Grade	C-	G-	G-	G <sup>0</sup>
Fat Thickness	0.40	0.10	0.20	0.10
% Kidney Fat	3.00	1.00	1.50	1.00
Ribeye Area	9.49	10.31	10.46	11.76
USDA Yield Grade	2.80	1.30	1.90	1.00
Est. % Boneless Cuts	50.50	53.90	52.60	54.60

<sup>1</sup>C = choice, G = Good

<sup>2</sup>A = 10-18 months of age  
B = 18-36 months of age

<sup>3</sup>Mt = moderate, Sl = slight, Tr = trace

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		A	B	H	L	A
Breed of dam		A	B	H	L	J
Line or group <sup>1</sup>		Purebred	Purebred	Purebred	Purebred	Purebred
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	77	15	223	28	36
	Yearling Heifers	17	2	45	4	5
	Bulls and steers under 1 year	3	4	38	4	
	Heifers under 1 year	5	4	44	11	
	Bulls over 1 year	11	6	41	14	8
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	71	42	88	68	100
	Calf survival <sup>3</sup> percent	77	88	81	69	92
Wean. perf.	180 days Adj. ADG <sup>4</sup>	1.7	1.6	1.6	1.7	1.7
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls	7	3	48	11	6
	No. of heifers			17	3	8
	No. of steers					
Slaughtered	No. of bulls			7	2	4
	No. of heifers			8	2	3
	No. of steers					
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

\* Unknown sire number

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		J	BS	G	B	G
Breed of dam		J	BS	G	H	H
Line or group <sup>1</sup>		Purebred	Purebred	Purebred	Purebred	Purebred
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	9				
	Yearling Heifers				5	3
	Bulls and steers under 1 year				8	
	Heifers under 1 year				11	
	Bulls over 1 year	2	1	2	6	14
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>				100	100
	Calf survival <sup>3</sup> percent				77	89
Wean. perf.	Adj. ADG <sup>4</sup>				1.8	1.7
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls				6	14
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		L	L	B	B	B
Breed of dam		H	1x	4x	23x	24
Line or group <sup>1</sup>						
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over	13	7	6	7	6
	Yearling Heifers	6				2
	Bulls and steers under 1 year	13			1	1
	Heifers under 1 year	8				1
	Bulls over 1 year	6				
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	93				100
	Calf survival <sup>3</sup> percent	74				50
Wean. perf.	Adj. ADG <sup>4</sup>	1.8				
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls	6				
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		BS	BS	H	L	L
Breed of dam		1x	H	57x	15x	72x
Line or group <sup>1</sup>		Grade	Grade	Grade	Grade	Grade
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over	21	27	6	6	5
	Yearling Heifers		5			2
	Bulls and steers under 1 year		15		4	2
	Heifers under 1 year		14		4	3
	Bulls over 1 year		2			
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>		93			80
	Calf survival <sup>3</sup> percent		69			50
Wean. perf.	Adj. ADG <sup>4</sup>		1.9			
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls		2			
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		L	L	L	L	L
Breed of dam		73x	3x	16x	82x	83x
Line or group <sup>1</sup>						
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over	1	1	2	1	
	Yearling Heifers	1				
	Bulls and steers under 1 year	1		1		
	Heifers under 1 year	1		2	2	1
	Bulls over 1 year	1				
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	100				
	Calf survival <sup>3</sup> percent	100				
Wean. perf.	Adj. ADG <sup>4</sup>	1.5				
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls	1				
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		BS	L	T	*	L
Breed of dam		A	A	H	A	57x
Line or group <sup>1</sup>						
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over	5	7			
	Yearling Heifers	6	3	11		
	Bulls and steers under 1 year	11			1	5
	Heifers under 1 year	12				
	Bulls over 1 year	6	12	3	1	3
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	93	86	95	100	100
	Calf survival <sup>3</sup> percent	100	84	83	100	70
Wean. perf.	Adj. ADG <sup>4</sup>	1.8	1.9	1.8	2.2	2.4
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls	6	12	4	1	3
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		58x	105x	200x	59x	57x
Breed of dam						
Line or group <sup>1</sup>						
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over					
	Yearling Heifers					
	Bulls and steers under 1 year	4	10	1	2	4
	Heifers under 1 year	8	12	3		
	Bulls over 1 year	2	11		1	8
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	91	71		100	82
	Calf survival <sup>3</sup> percent	90	94		75	89
Wean. perf.	Adj. ADG <sup>4</sup>	2.0	1.8		2.2	2.0
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls	2	11		1	8
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		G	G	G	G	A
Breed of dam						
Line or group <sup>1</sup>						
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over					
	Yearling Heifers					
	Bulls and steers under 1 year	3	3			
	Heifers under 1 year	1	2			
	Bulls over 1 year	4	2	2	1	3
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	70	75	100	100	50
	Calf survival <sup>3</sup> percent	100	67	100	100	100
Wean. perf.	Adj. ADG <sup>4</sup>	2.0	1.7	1.6	2.2	2.0
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls	4	2	2	1	3
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		BS	BS	B	J	J
Breed of dam		16x	15x	J	A	23x
Line or group <sup>1</sup>						
Percent used in project						
Inventory as of July 1, 1971	Cows 2 years and over					
	Yearling Heifers					
	Bulls and steers under 1 year				10	3
	Heifers under 1 year			4	13	3
	Bulls over 1 year	1	1			
	Steers over 1 year					
Repro. perf.	Percent pregnant <sup>2</sup>	100	100			
	Calf survival <sup>3</sup> percent	33	100			
Wean. perf.	Adj. ADG <sup>4</sup>	1.7	2.2			
	Av. type score <sup>5</sup>					
Postweaning performance	No. of bulls	1	1			
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.  
 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.  
 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.  
 4 - Indicate adjustments:  
 5 - Suggest S-10 scoring system; indicate if different.

CATTLE BREED & CROSS CODE

Breed or Cross	:	Dam Breeding	:	Sire Breeding	:	Progeny Breeding
A	Angus		Angus		Angus	
B	Brahman		Brahman		Brahman	
BS	Brown Swiss		Brown Swiss		Brown Swiss	
G	Santa Gertrudis		Santa Gertrudis		Santa Gertrudis	
H	Hereford		Hereford		Hereford	
J	Jersey		Jersey		Jersey	
L	Charolais		Charolais		Charolais	
T	Simmental		Simmental		Simmental	
1x	Hereford		Brahman		1/2 H - 1/2 B	
11x	Hereford		Santa Gertrudis		1/2 H - 1/2 G	
15x	Hereford		Charolais		1/2 H - 1/2 L	
16x	1x & 2x		Charolais		1/2 L - 1/4 H - 1/4 B	
23x	4x		Brahman		7/8 B - 1/8 H	
24x	23x		Brahman		15/16 B - 1/16 H	
25x	24x		Brahman		31/32 B - 1/32 H	
30x						
31x						
57x	1x		Brown Swiss		1/2 BS - 1/4 H - 1/4 B	
58x	H		Brown Swiss		1/2 BS - 1/2 H	
59x	57x		Hereford		1/2 BS - 5/8 H - 1/8 B	
72x	15x		Charolais		3/4 L - 1/4 H	
73x	72x		Charolais		7/8 L - 1/8 H	
74x	73x		Charolais		15/16 L - 1/16 H	
76x	3x, 5x, 9x		Charbray		7/16 L - 3/8 H - 3/16 B	
82x	16x		Charolais		3/4 L - 1/8 H - 1/8 B	

## CATTLE BREED &amp; CROSS CODE (continued)

Breed	:	:	:
or	:	Dam	Sire
Cross	:	Breeding	Breeding
			Progeny
			Breeding
83x	82x	Charolais	7/8 L - 1/16 H - 1/16 B
84x	83x	Charolais	15/16 L - 1/32 H - 1/32 B
105x	J	A	
115x	24x	A	
200x	A	BS	
250x	A	L	
260x	105x	L	
270x	200x	L	
290x	59x	L	
355x	57x	G	
360x	15x	G	
365x	58x	G	
370x	250x	G	
380x	16x	G	
555x	J	B	
600x	H	T	
620x	A	J	
635x	24x	J	
185x	16x	BS	
210x	15x	BS	

VIRGINIA POLYTECHNIC INSTITUTE  
Animal Science Department  
Blacksburg, Virginia

I. PROJECT: 206100 (S-10)  
Heterosis from crosses among British breeds of beef cattle.

II. OBJECTIVES:

To measure heterosis obtained from crosses among the Angus, Hereford, and Shorthorn breeds, as shown by fertility and livability, growth rate, fattening ability and carcass quality. To compare straightbred cows with crossbred cows on the basis of lifetime production.

III. PERSONNEL:

M. B. Wise, F. S. McClaugherty, J. S. Copenhaver, R. C. Carter, W. H. McClure, and J. A. Gaines.

IV. ACCOMPLISHMENTS DURING THE YEAR:

A. The objective of the phase of the experiment to be reported here is to compare straightbred calves from straightbred dams with crossbred calves from crossbred dams. This is a continuation of previously reported results from crossing the Angus, Hereford and Shorthorn breeds and it is preliminary to results comparing straightbreeding with rotational crossbreeding. The cow herd consisting of sixty purebreds (Angus, Hereford and Shorthorn) and sixty crossbreds (reciprocal two-breed crosses) among these three breeds was purchased as calves in 1960. The first five calf crops from these cows were used to compare straightbred and crossbred cows and the results have been reported previously. The sixth, seventh and eighth calf crops will be used to compare straightbred calves with three-breed cross calves out of two-breed cross dams. Results from the three calf crops through weaning are complete and will be reported here: 156 straightbred matings weaned 135 calves (86.6%) 159 crossbred matings weaned 152 calves (95.6%).

	Steers		Heifers	
	Straight	Cross	Straight	Cross
No. of calves <sup>1</sup>	71	80	75	73
Birth date	Feb. 10	Feb. 9	Feb. 11	Feb. 8
Birth wt.	74	83	69	75
Wean wt.	496	549	456	496
Feeder grade at wean. <sup>3</sup>	12.0	12.4	11.6	12.2
No. of calves <sup>2</sup>	48	51	25	22
ADG on feed	2.06	2.12	1.43	1.51
Slaughter wt.	924	1000	750	790
Slaughter grade <sup>3</sup>	12.0	12.3	11.7	11.9
Carcass wt.	544	592	439	461
Carcass grade <sup>3</sup>	11.8	11.6	10.7	11.1
Dressing %	58.9	59.1	58.3	58.2
Loin eye area	10.22	11.04	9.04	8.70

<sup>1</sup>Three calf crops birth to weaning, inclusive

<sup>2</sup>Two calf crops of steers and one crop of heifers, postweaning

<sup>3</sup>Grade code: 11, Good plus; 12, Choice minus

There are large differences in percent weaned, birth weight, weaning weight, slaughter weight and carcass weight. Differences in quality, as measured by feeder grade, slaughter grade, and carcass grade are negligible.

- B. Phase two cow herd was transferred to the farm of a cooperating producer to complete the study of lifetime production.
- C. Phase three cow herd began its first breeding season approximately April 15, 1971.

#### V. FUTURE PLANS:

Phase three will proceed according to plan.

#### VI. PUBLICATIONS:

Gaines, J. A., G. V. Richardson, R. C. Carter and W. H. McClure. 1970. General combining ability and maternal effects in crossing three British breeds of beef cattle. J. Animal Sci. 31:19-26.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Shenandoah Valley Research Station

Location		Steeles Tavern Virginia		R. B. Dunlap cooperator	
Breed of sire		var.		var.	
Breed of dam		var.		var.	
Line or group <sup>1</sup>		pure & cross.		pure & cross.	
Percent used in project		95		100	
Inventory as of July 1,	Cows 2 years and over	120		89	
	Yearling Heifers	---		---	
	Bulls and steers under 1 year	---		---	
	Heifers under 1 year	---		---	
	Bulls over 1 year	12		4	
	Steers over 1 year	---		---	
Repro. perf.	Percent pregnant <sup>2</sup>				
	Calf survival <sup>3</sup> percent				
Wean. perf.	Adj. ADG <sup>4</sup>				
	Av. type score <sup>5</sup>				
Postweaning performance	No. of bulls				
	No. of heifers				
	No. of steers	47			
Slaughtered	No. of bulls				
	No. of heifers				
	No. of steers	47			
Remarks:					

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

BEEF CATTLE RESEARCH STATION  
Front Royal, Virginia

I. PROJECT: CRIS Unit 03 30 019 313a 49

Breeding superior beef cattle for Virginia

II. OBJECTIVES:

To compare changes in performance and breeding values from two breeding systems: (a) single trait mass selection, and (b) the formation of intensely inbred lines for subsequent use in top and rotational crossing.

To evaluate selection criteria and procedures and to develop more precise and effective measures of quality and performance in beef cattle.

To simplify methods of individual, progeny, and sib testing so that the performance of breeding cattle can be evaluated at young ages.

III. PERSONNEL:

B. M. Priode, K. P. Bovard, M. B. Wise, R. C. Carter, P. A. Putnam and W. T. Butts, Jr.

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work:

During the year, the first of four years' diallel cross calves were compared with inbreds and growth selection calves.

The previous year's study of reproductive development--age at first heat--with 48 Angus heifers on ROP test was expanded to include 81 heifers in 1970-71.

Quarantine lots were completed in the northwest corner of the Station for holding new additions to the herd inventory.

In the Marvin Maddox area, surplus property was used in construction of one new feedlot for heifers, and six new pens for sorting cattle.

2. Research results:

A. Diallel calves compared. Shown in table 1 are the ADG's for calves from each breeding class--inbred, linecross, and growth--in May, July and September. Growth selection calves excelled in ADG's each month, but their advantage over inbreds and linecross calves got smaller from May to September.

Table 1. ADG's of 1970 calves by months and breeding, Beef Cattle Research Station, Front Royal, Virginia.

Breed	Class	N	Fd	Fc	ADG (lb.) to		
					May	July	September
A	Inbred	19	.26	.37	1.42	1.68	1.66
	Linecross	30	.27	0	1.56	1.88	1.91
	Growth	27	.06	.01	1.80	1.95	1.96
S	Inbred	18	.36	.46	1.25	1.38	1.45
	Linecross	27	.29	.02	1.44	1.66	1.63
	Growth	27	.07	.13	1.76	1.88	1.91

- B. Bulls carried longer. Gestation periods of male calves appear to be about 3.2 days longer than those of female calves. If the fetal ADG, late in gestation, is about 1.0 to 1.5 lbs., this would nicely explain the sex differences in birth weights. Also, calves from inbred matings were born almost five days later than those from selection matings, shown in table 2. These findings came from an analysis of birth and subsequent monthly weights of 1645 calves born 1962-67, inclusive. Next question: What causes the apparently longer gestation of bull calves?

Table 2. Average day of birth<sup>a</sup> (and number of calves) by sex and mating system of calf, 1962-67.

Mating system	Sex		Average
	Bull	Heifer	
Inbred	83.4 (391)	82.0 (327)	82.8 (718)
Selection	80.2 (465)	76.0 (462)	78.1 (927)
Average	81.7 (856)	78.5 (789)	80.2 (1645)

<sup>a</sup>Where day 80 = 21 March; day 81 = 22 March, etc.  
Standard deviation was  $\pm 25.2$  days.

- C. Thin heifers better? Growth, fatness and puberty traits are presented in table 3 for inbred, type and growth selection heifers studied last year. Finding "growth" heifers intermediate in condition score and thinnest in ultrasonic measures of fatness, while finding the "type" selection heifers fattest in condition score and intermediate in ultrasonic fatness has practical promise. The results of the heifers' reproduction, i.e., calves performance and their calves' subsequent growth will be essential for conclusive interpretation of the study.
- D. White heifer trouble. Calf #9250 FS8, was diagnosed in October as having "white heifer disease." On examination after slaughter 11 February, no functional reproductive tract was found. Dr. Meacham said "The Heifer showed arrested sexual differentiation, and had both male and female primordial duct systems. Normally one of these two systems develops, and the other regresses as embryonic development proceeds. But, this did not happen."

with the heifer examined." Another white heifer, 0132 FS8, whose grandsire, 6188 was the sire of 9250, was diagnosed abnormal when palpated 10 February 1971 by Dr. Meacham. Special photographs and other documentation of this abnormality was handled by Dr. Meacham in Blacksburg.

- E. Sonoray repeatability. Seven-month-old heifers had 1.62 mm fat, 0.32 mm (P<.01) more than bull calves at the same age. Heifers' hides were 5.07 mm, 0.39 mm thicker than bulls' (P<.01). Hide thicknesses were: for Shorthorns, 4.42; for Angus, 4.92; and, for Herefords, 5.29 mm (P<.01). Least fat was seen in Herefords with 1.26, next were Shorthorns with 1.53, and fattest were Angus with 1.58 (P<.05). Sonoray repeatabilities were 0.68 for fat, 0.69 for hide thickness, and 0.76 for the combination, hide plus fat, estimated as intraclass correlations. Results came from duplicate readings, both before and after clipping of all calves, in early November 1970. Details appear in table 4, attached.
- F. Second Snorter seen. A 46% inbred Snorter dwarf calf, number 1064 MA1, was born 15 March, died 16 March. It was the second dwarf born in A-1, the first in seven years since 3243 FA1. A path-pedigree is enclosed as figure 1, showing the dwarf and relevant ancestors. The dwarf was the fourth calf from this son-dam mating. The others, 8083, 9062, and 0089, all males, were apparently normal. The dwarf was the fifth calf out of 4193, her first being 6062, the son to which she was mated to produce the three normal calves cited earlier and this year's dwarf, 1064. The maternal granddam, 1510, almost certainly a dwarf carrier, has had nine calves in ten years. She is still on inventory, used for linecross matings in the last two years.

#### V. FUTURE PLANS:

- A. Continuation of diallel testing is planned for three more calf crops, comparing purebred linecross, inbred and growth selection calves in Angus and Shorthorn.
- B. Yearling single cross heifers will be bred to an inbred bull of a third line.
- C. Pinkeye studies, cooperative with Veterinary Science, Entomology and Animal Science at VPI, will be initiated.
- D. A study of digestible energy intake, cooperative with David Dinius and others at Beltsville, will be started in 1971 with 20 steers of conventional British breeding, and 20 of a large breed, Santa Gertrudis, to examine relationships of optimum ration composition, feed intake, conversion, and slaughter weight.

#### VI. PUBLICATIONS:

- Bovard, K. P., N. W. Hooven, and B. M. Priode. 1970. Comparisons of methods of identifying experimental cattle: freeze branding and plastic ear tags. Va. J. Sci.n.s. 21:101 (Abstr.).
- Bovard, K. P., and B. M. Priode. 1970. Ultrasonic estimates of hide and fat thickness in beef calves on postweaning growth tests at Front Royal. Va. J. Sci.n.s. 21:101 (Abstr.).

Meacham, T. M., K. P. Bovard and B. M. Priode. 1970. Effects of supplemental vitamin A on the performance of beef cows and their calves. J. Animal Sci. 31:428-433 (August 1970).

VII. PUBLICATIONS PLANNED:

Bovard, K. P., J. P. Fontenot and B. M. Priode. 1971. Accumulation and dissipation of heptachlor residues in fattening steers. J. Animal Sci. 33: (In Press).

Bovard, K. P., F. D. Griffith and B. M. Priode. 1971. Variation in seven pesticide residues in apple pomace. Va. J. Sci. 22: (In Press.).

Bovard, K. P., N. W. Hooven and B. M. Priode. 1971. Effects of timing and breed on legibility of freeze brands in beef heifers. Va. J. Sci. 22: (In Press)

Bovard, K. P., T. N. Meacham and B. M. Priode. 1971. Patterns of growth, fattening and reproductive development in heifer calves to one year. Va. J. Sci. 22: (In Press).

Bovard, K. P., R. L. Wilson and B. M. Priode. 1971. Breed and sex differences in means and repeatabilities of ultrasonic readings of hide and fat thickness in beef calves 6-12 months old. Va. J. Sci. 22: (In Press).

**BEEF CATTLE RESEARCH STATION  
FRONT ROYAL, VIRGINIA 22630**

FIG. 1. PATH PEDIGREE OF DWARF CALF 1064 M A-1.

**F<sup>c</sup> - BELOW AN. NO., SELECTED.**

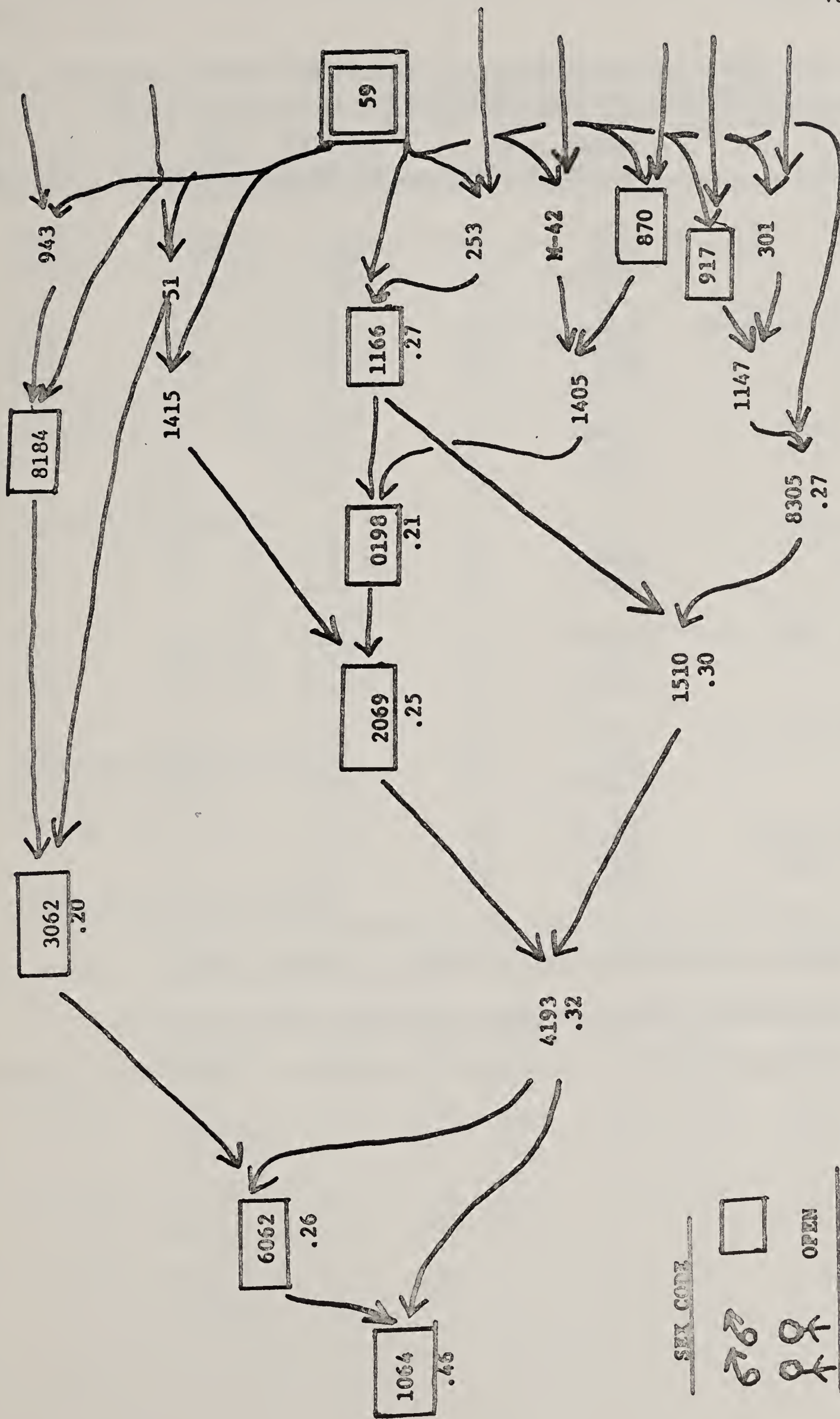


Table 3. Growth and development of Angus heifer calves from inbred, type and growth selection lines at Front Royal.

Variable	Mating system	No. calves	Oct. '69 212 days	Jan. '70 287 days	Mar. '70 352 days	May '70 418 days
Weight, lb.	Inbred	23	374	468	575	650
	Type	11	442	527	635	685
	Growth	14	455	572	694	755
Condition score <sup>a</sup>	Inbred	23	8.0	10.2	10.4	11.7
	Type	11	9.0	11.4	12.2	12.7
	Growth	14	8.5	10.3	11.4	11.7
Fat, mm. <sup>b</sup>	Inbred	23	2.65	3.13	3.91	3.94
	Type	11	2.63	3.09	3.40	3.63
	Growth	14	2.61	2.71	3.50	3.53
Puberty <sup>c</sup>	Inbred	23	0.3	0.4	1.0	1.9
	Type	11	0.9	0.9	1.3	1.9
	Growth	14	0.7	0.5	1.5	2.0
Body length, in.	Inbred	23	26.8	29.0	31.3	32.0
	Type	11	27.6	28.3	32.1	32.4
	Growth	14	28.8	29.4	32.9	32.9
Wither ht., in.	Inbred	23	35.0	35.8	38.1	39.2
	Type	11	34.9	35.5	38.3	39.4
	Growth	14	37.2	37.8	41.0	42.5
Pelvic area, sq. inch	Inbred	23	--	--	--	25.0
	Type	11	--	--	--	23.1
	Growth	14	--	--	--	25.3

<sup>a</sup>Subjective ratings, with 10 = Good; 11 = High good; 12 = Low choice, etc.

<sup>b</sup>Ultrasonic estimate, 4 inches off spine, behind 12th rib.

<sup>c</sup>Palpation score: 0 = too small to palpate; 1 = prepuberal; 2 = puberal.

Table 4. Analyses of variance (AOV), variance components, intraclass correlations, means ( $\bar{x}$ 's) and standard errors (S.E.'s) for results of ultrasonic estimates of hide (H), fat (F), and hide plus fat (H+F) thickness (mm) in 7-month old bull and heifer calves. Data from November 1970. Beef Cattle Research Station, Front Royal, Virginia.

A. <u>Analyses of variance</u>		Hide		Fat		Hide + Fat	
<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>MS</u>	<u>F</u>	<u>MS</u>	<u>F</u>
Sex	1	17.40	13.1**	12.18	11.8**	58.70	19.5**
Breed	2	30.97	23.5**	3.25	3.1*	24.26	8.1**
SxB	2	0.79	<1	0.50	<1	1.21	<1
Calves/SB	156	1.33	9.8**	1.04	9.5**	3.01	14.0**
Within CFS	486	0.14		0.11		0.21	
Total	647						

B. <u>Variance components</u>				
	$\hat{\sigma}_e^2$	0.14	0.11	0.21
	$\sigma_c^2$	.30	.23	.70
	$\sigma_e^2 + \sigma_c^2$	.43	.34	.91
	$\hat{\sigma}_t^2$	.55	.36	1.06

C. <u>Intraclass correlation</u>			
$r_I - \sigma_c^2 / (\sigma_c^2 + \sigma_e^2):$	0.69	0.68	0.76

D. <u>Means and standard errors</u>								
	<u>Class</u>	<u>N</u>	<u><math>\bar{x} \pm S. E.</math></u>		<u><math>\bar{x} \pm S. E.</math></u>		<u><math>\bar{x} \pm S. E.</math></u>	
	Mu	648	4.87	.030	1.46	.047	6.34	.044
Sex:	Males	82	4.68	.039	1.30	.060	5.98	.056
	Females	80	5.07	.046	1.62	.072	6.69	.067
Breeds:	Angus	72	4.92	.039	1.58	.060	6.50	.056
	Shorthorn	67	4.42	.040	1.53	.062	5.95	.058
	Hereford	23	5.29	.071	1.26	.111	6.56	.104
Readings:	First	324	4.85	.040	1.45	.019	6.30	.057
	Second	324	4.90	.040	1.47	.019	6.37	.057
Clipping:	Unclipped	324	4.86	-	1.44	.023	6.31	-
	Clipped	324	4.89	-	1.48	.023	6.37	-

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Angus	Angus	Angus	Angus	Angus
Breed of dam		Angus	Angus	Angus	Angus	Angus
Line or group <sup>1</sup>		A1	A1xA2	A1xA3	A1xA4	A2
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	28	-	-	-	33
	Yearling Heifers	4	-	1	2	1
	Bulls and steers under 1 year	5	2	2	-	7
	Heifers under 1 year	3	4	4	-	4
	Bulls over 1 year	4	-	2	4	5
	Steers over 1 year	-	-	-	-	-
Repro. perf.	Percent pregnant <sup>2</sup>	78	-	100	100	60
	Calf survival <sup>3</sup> percent	100	-	60	86	67
Wean. perf.	Adj. ADG <sup>4</sup>	1.80	-	2.08	1.97	1.60
	Av. type score <sup>5</sup>	11.6	-	12.8	12.1	10.8
Postweaning performance	No. of bulls	3	-	2	4	3
	No. of heifers	4	-	1	2	1
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments:
- 5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Angus	Angus	Angus	Angus	Angus
Breed of dam		Angus	Angus	Angus	Angus	Angus
Line or group <sup>1</sup>		A2xA1	A2x3	A2x4	A3	A3xA1
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	-	-	-	22	-
	Yearling Heifers	-	2	3	2	2
	Bulls and steers under 1 year	4	1	-	4	2
	Heifers under 1 year	2	6	-	4	1
	Bulls over 1 year	-	2	-	2	1
	Steers over 1 year	-	-	-	-	-
Repro. perf.	Percent pregnant <sup>2</sup>	-	83	60	50	43
	Calf survival <sup>3</sup> percent	-	80	100	75	100
Wean. perf.	Adj. ADG <sup>4</sup>	-	1.98	2.16	1.82	2.08
	Av. type score <sup>5</sup>	-	12.3	12.0	12.1	12.5
Postweaning performance	No. of bulls	-	2	-	1	1
	No. of heifers	-	2	3	2	2
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Angus	Angus	Angus	Angus	Angus
Breed of dam		Angus	Angus	Angus	Angus	Angus
Line or group <sup>1</sup>		A3x2	A3x4	A4	A4xA1	A4xA2
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	-	-	27	-	-
	Yearling Heifers	-	-	3	3	2
	Bulls and steers under 1 year	-	4	3	-	5
	Heifers under 1 year	-	3	3	-	-
	Bulls over 1 year	2	-	4	3	2
	Steers over 1 year	-	-	-	-	-
Repro. perf.	Percent pregnant <sup>2</sup>	29	-	100	100	57
	Calf survival <sup>3</sup> percent	100	-	50	100	100
Wean. perf.	Adj. ADG <sup>4</sup>	2.34	-	1.83	1.91	1.88
	Av. type score <sup>5</sup>	12.5	-	11.2	12.4	11.6
Postweaning performance	No. of bulls	2	-	2	3	2
	No. of heifers	-	-	3	3	2
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks:						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments: age of dam, season of birth, sex and creep feeding.
- 5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Angus	Angus	Angus	Angus	Hereford
Breed of dam		Angus	Angus	Angus	Angus	Hereford
Line or group <sup>1</sup>		A4xA3	A6	A8	TOTAL	Various
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	-	-	28	138	-
	Yearling Heifers	-	-	13	38	-
	Bulls and steers under 1 year	2	-	13	54	-
	Heifers under 1 year	2	-	12	48	-
	Bulls over 1 year	-	1	9	41	5
	Steers over 1 year	-	-	-	-	-
Repro. perf.	Percent pregnant <sup>2</sup>	-	95	96	80	-
	Calf survival <sup>3</sup> percent	-	80	100	85	-
Wean. perf.	Adj. ADG <sup>4</sup>	-	1.93	2.08	1.97	-
	Av. type score <sup>5</sup>	-	11.6	12.3	12.0	-
Postweaning performance	No. of bulls	-	-	8	33*	-
	No. of heifers	-	-	13	38	-
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks: *plus 1 outside bull for ROP Test.						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: age of dam, season of birth, sex and creep feeding

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Hereford	Hereford	Shorthorn	Shorthorn	Shorthorn
Breed of dam		Hereford	Hereford	Shorthorn	Shorthorn	Shorthorn
Line or group <sup>1</sup>		H8	TOTAL	S1	S1x2	S1xS4
Percent used in project		100	100	100	100	100
Inventory as of July 1.	Cows 2 years and over	31	31	21	-	-
	Yearling Heifers	9	9	3	-	3
	Bulls and steers under 1 year	14	14	4	4	-
	Heifers under 1 year	11	11	2	1	4
	Bulls over 1 year	13	18	3	-	-
	Steers over 1 year	-	-	-	-	-
Repro. perf.	Percent pregnant <sup>2</sup>	81	81	62	-	67
	Calf survival <sup>3</sup> percent	92	92	80	-	75
Wean. perf.	Adj. ADG <sup>4</sup>			1.38	-	1.73
	Av. type score <sup>5</sup>			10.8	-	12.4
Postweaning performance	No. of bulls	15	15	1	-	-
	No. of heifers	9	9	3	-	3
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: age of dam, season of birth, sex and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

6 - See reverse side.

Following the breeding season, pregnant Hereford cows were assigned to one of three treatments in a reproductive study. Treatments and the performance of the calves in each were:

	<u>No. Cows</u>	<u>Adj. ADG</u>	<u>Avg. T.S.</u>
#1 Control	9	1.65	12.3
#2 Cows fed urea-molasses ad lib, beginning 3 months prior to calving and continuing until weaning.	9	2.15	12.7
#3 Calves weaned < 4 days after birth.	9	Not Adj.	8.8

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	
Breed of sire		Shorthorn	Shorthorn	Purebred	Various	
Breed of dam		Shorthorn	Shorthorn	Purebred	Various	
Line or group <sup>1</sup>		S9	TOTAL	Herd Total	Crossbred	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1971	Cows 2 years and over	-	139	308	-	
	Yearling Heifers	-	34	81	-	
	Bulls and steers under 1 year	-	47	115	1	
	Heifers under 1 year	-	44	103	-	
	Bulls over 1 year	2	44	103	-	
	Steers over 1 year	-	-	-	-	
Repro. perf.	Percent pregnant <sup>2</sup>	-	70	76	-	
	Calf survival <sup>3</sup> percent	-	88	87	-	
Wean. perf.	Adj. ADG <sup>4</sup>	-	1.80	-	-	
	Av. type score <sup>5</sup>	-	11.7	-	-	
Postweaning performance	No. of bulls	2*	33	81	-	
	No. of heifers	-	34	81	-	
	No. of steers	-	-	-	-	
Slaughtered	No. of bulls	-	-	-	-	
	No. of heifers	-	-	-	-	
	No. of steers	-	-	-	-	
Remarks: *2 Outside bulls on ROP Test.						

- 1 - Purebreds, grade, line sire number, crosses, treatment, etc.
- 2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
- 3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
- 4 - Indicate adjustments: age of dam, season of birth, sex and creep feeding.
- 5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Shorthorn	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Breed of dam		Shorthorn	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Line or group <sup>1</sup>		S5xS1	S5xS2	S5xS4	S8	S7
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	-	-	-	44	-
	Yearling Heifers	-	-	-	12	-
	Bulls and steers under 1 year	-	1	2	21	-
	Heifers under 1 year	-	2	2	17	-
	Bulls over 1 year	-	-	-	10	2
	Steers over 1 year	-	-	-	-	-
Repro. perf.	Percent pregnant <sup>2</sup>	00	0	-	75	-
	Calf survival <sup>3</sup> percent	-	-	-	93	-
Wean. perf.	Adj. ADG <sup>4</sup>	-	-	-	2.04	-
	Av. type score <sup>5</sup>	-	-	-	12.2	-
Postweaning performance	No. of bulls	-	-	-	8	-
	No. of heifers	-	-	-	12	-
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: age of dam, season of birth, sex and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Shorthorn	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Breed of dam		Shorthorn	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Line or group <sup>1</sup>		S4	S4xS1	S4xS2	S4xS5	S5
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	29	-	-	-	22
	Yearling Heifers	5	1	2	-	-
	Bulls and steers under 1 year	4	4		-	2
	Heifers under 1 year	3	2		2	1
	Bulls over 1 year	6	6	3	-	1
	Steers over 1 year	-	-	-	-	-
Repro. perf.	Percent pregnant <sup>2</sup>	100	100	83	-	0
	Calf survival <sup>3</sup> percent	90	100	100	-	-
Wean. perf.	Adj. ADG <sup>4</sup>	1.72	1.71	1.72	-	-
	Av. type score <sup>5</sup>	11.1	11.8	11.8	-	-
Postweaning performance	No. of bulls	4	6	3	-	-
	No. of heifers	5	1	2	-	-
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: age of dam, season of birth, sex and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

## Production, Inventory, and Performance Data, S-10 Herds - 1970-1971

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Shorthorn	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Breed of dam		Shorthorn	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Line or group <sup>1</sup>		S1xS5	S2	S2xS1	S2xS1	S2xS5
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1971	Cows 2 years and over	-	23	-	-	-
	Yearling Heifers	2	2	-	2	2
	Bulls and steers under 1 year	-	2	2	-	1
	Heifers under 1 year	-	5	2	-	1
	Bulls over 1 year	3	5	-	3	-
	Steers over 1 year	-	-	-	-	-
Repro. perf.	Percent pregnant <sup>2</sup>	100	100	-	100	60
	Calf survival <sup>3</sup> percent	100	71	-	71	67
Wean. perf.	Adj. ADG <sup>4</sup>	1.58	1.53	-	1.68	1.86
	Av. type score <sup>5</sup>	11.5	10.2	-	11.6	11.4
Postweaning performance	No. of bulls	3	3	-	3	-
	No. of heifers	2	2	-	2	2
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks:						

1 - Purebreds, grade, line sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

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